New York State College of Agriculture and Life Sciences

Administration

David L. Call, dean
Joan R. Egner, associate dean
George J. Conneman, director of instruction
Helen L. Wardeberg, associate director of instruction
Theodore L. Hullar, director of research and director of the New York State Agricultural Experiment Station (Ithaca)
Lamartine F. Hood, associate director of research
Lucinda A. Noble, director of cooperative extension
David T. Smith, associate director of cooperative extension
Donald W. Barton, director of the New York State Agricultural Experiment Station (Geneva)
Joseph F. Metz, Jr., director of international agriculture

Office of Instruction Staff

Student affairs: D. Burgett
Minority affairs: Professor D. Graham, E. Paddio-Reed
Registrar: R. Stanton
Scheduling: C. Place
Admissions: N. Cartland, R. Church, M. Grainger
Career planning and placement: W. Alberta

Department Chairpersons

Agricultural economics: O. D. Forker, Warren Hall
Agricultural engineering: N. R. Scott, Riley-Robb Hall
Agronomy: R. F. Lucey, Emerson Hall
Animal science: R. J. Young, Morrison Hall
Communication arts: D. F. Schwartz, Roberts Hall
Education: J. P. Bail, Stone Hall
Entomology: M. J. Tauber, Comstock Hall
Floriculture and ornamental horticulture: C. F. Gortzig, Plant Sciences Building
Food science: J. E. Kinsella, Stocking Hall
Microbiology: R. P. Mortlock, Stocking Hall
Natural resources: W. H. Everhart, Fernow Hall
Plant breeding and biometry: W. D. Pardee, Emerson Hall
Plant pathology: W. E. Fry, Plant Sciences Building
Pomology: W. J. Kender, Plant Sciences Building
Poultry science: R. C. Baker, Rice Hall
Rural sociology: E. C. Erickson, Warren Hall
Statistics and biometry: W. T. Federer, Warren Hall
Vegetable crops: R. D. Sweet, Plant Sciences Building

Facilities

The College of Agriculture and Life Sciences (CALS) is located on the upper campus, up the hill from the central area of Cornell University, on land that was once part of the Ezra Cornell family farm and is commonly known as the Ag Quad. Anchored on the east by Mann Library, the quadrangle buildings house classrooms, offices, and laboratories, and are flanked by greenhouses, gardens, and research facilities. Nearby are the orchards, barns, field plots, forests, and streams that extend as far as the Animal Science Teaching Research Center at Harford and the Experiment Station at Geneva.

Administrative units including the dean's office and the Office of Instruction are located in Roberts Hall. Information about academic programs, student records, graduation requirements, career planning, financial aid, placement, and counseling may be obtained there. The student lounge and service center of the college is in the Alfalfa Room, across the Ag Quad in Warren Hall. Computer facilities are available in 160 Warren Hall and in 15A Riley-Robb Hall.

Advising and Counseling Services

Faculty in the College of Agriculture and Life Sciences recognize that students need information and advice to make intelligent decisions while in college. Students are assigned to a faculty adviser soon after being admitted to the college. An effort is made to match the student's and the faculty member's interests as closely as possible.

The Office of Student Affairs has overall responsibility for coordinating the college advising and counseling program. Inquiries regarding procedures and services should be directed to Dr. Donald Burgett, 17 Roberts Hall (telephone: 256-2257). Students may change advisers if their academic interests change, or if they feel their needs can be better served. Change of adviser forms are available from this office.

The Minority Affairs Office in the College of Agriculture and Life Sciences works in conjunction with the University-wide COSEP Program to provide counseling, tutoring, advising, and referrals of students to agencies that will meet their special needs. The Educational Opportunity Program (EOP) is a state-supported program intended to assist New York State students who meet specific economic and academic criteria set by the New York State Education Department. Students in the College of Agriculture and Life Sciences who are eligible should apply to the program. Forms are available in 14 Roberts Hall. Interested students should contact the director for minority programs, Prof. D. Graham, or the minority counselor, Ms. Paddio-Reed (telephone: 256-6588).

The Office of Career Planning and Placement offers a variety of services to all students and alumni of the college. For further information, contact William Alberta, 16 Roberts Hall (telephone: 256-2215).

The college registrar maintains for each student a complete record of academic achievement. A permanent record card is on file for each matriculated student and is updated whenever new information becomes available.

The progress of each student toward meeting the degree requirements is recorded in the college registrar's office on a summary of record form. Worksheets are available on which students can keep their own record of courses taken toward meeting the distribution and elective requirements. Data on the worksheet can be used by the student in planning course selection each term to assure reasonable progress toward meeting degree requirements.

Staff members are available in 192 Roberts Hall to consult with students regarding the assignment of credit toward meeting distribution and elective requirements and to verify the official summary of record.

Financial Aid

Financial aid is administered through the University office in Day Hall. Endowment funds and annual donations provide supplemental aid for students in the college. Awards recommended by the College Scholarship Committee become part of the total financial package offered through the University's Office of Financial Aid.

A small loan fund is administered by the college through the Office of Instruction. The purpose of the fund is to assist students facing short-term emergencies. The loans are interest-free and are usually made for no more than ninety days. For information, contact the Office of Instruction, at 256-4569 or 256-2257.

Students

The CALS undergraduate enrollment is 3000, with about 60 percent in the upper division. Each year about 850 students are graduated, while 600 freshmen and 250 transfer students are admitted. Over 300 faculty members serve as advisers for undergraduates. About 1000 graduate students have members of the faculty of the college serving as chairpersons of their Special Committees.

The College Admissions Committee selects applicants who are academically well prepared and appear most likely to profit from the college's various curricula.

Most students come from New York State, but about 15 percent come from other parts of the United States or abroad. Nearly half of the undergraduates are women. About 7 percent are identified as members of minority or ethnic groups.

Transfer Students

Any student who has withdrawn from one college and has been accepted in CALS is considered a transfer student. Approximately 20 percent of the undergraduate students are transfers who have taken part of their collegiate work at community colleges, agricultural and technical colleges, or other two-year institutions. Many of these hold an Associate degree. Other transfer students, including those from other colleges at Cornell, may also be admitted.

A Cornell student in good standing may apply for *intra-University transfer* to pursue a course of study unavailable in his or her current college. Guidelines are available in the Admissions Office of the College of Agriculture and Life Sciences, 195 Roberts Hall. The procedure includes filing a transfer request in the Office of the University Registrar, 222 Day Hall, and submitting a letter explaining reasons for making the transfer.

Consideration is given to students who have demonstrated an interest in their intended field of study by taking appropriate prerequisite courses and courses within this area of study. Academic achievement is also considered. Students are seldom allowed to transfer during their freshman year. In some cases, students may transfer directly into CALS. In other cases, the student may be referred to the Division of Unclassified Students to study for one semester before entering the college. A second semester is considered under unusual circumstances. During this trial semester, the student must achieve a predetermined average (usually 2.7) and take approved courses to assure acceptance.

Special Students

A limited number of non–degree candidates who want to take selected courses in the college are admitted each year. Applicants should submit the standard Cornell application, a résumé of their work experience, and an outline of the courses they want to take. For more information, contact the Admissions Office, 195 Roberts Hall (telephone: 256-2036).

Part-time Study

All students in the College of Agriculture and Life Sciences are expected to be enrolled as full-time students in a registered program of study. Part-time students must register in the Division of Summer Session, Extramural Courses, and Related Programs. The Continuing Education Center, 103 Barnes Hall, provides information, counseling, and special programs for mature students throughout the University (telephone: 256-4987).

Degree Programs

Field of Study	*HEGIS Code*	*Department Chairperson*	*Undergraduate Coordinator*	*Graduate Faculty Representative*
*Agricultural Economics***	0111	O. Forker	D. Goodrich	W. Tomek
Business Management and Marketing	0112			
Farm Finance and Management	0110			
Food Industry Management	0112			
*Agricultural Engineering***	0903	N. Scott	D. Ludington	G. Rehkugler
Agricultural Engineering Technology				
Environmental Technology	0199			
*Agronomy**		R. Lucey		J. Duxbury
Atmospheric Science	1913		B. Dethier	
Field Crops	0102		G. Fick	
Soils	0103		T. Scott	
*Animal Science***	0104	R. Young	J. Stouffer	R. Quaas
Animal Breeding*				D. VanVleck
Biological Sciences (Div. of)		R. Barker, dir.		
Biology, General	0401		H. Stinson	
Biochemistry**	0414			K. Moffat
Botany/Plant Biology**	0402			P. Davies
Ecology, Systematics, and Evolution**	0420			P. Marks
Genetics and Development**	0422			S. Zahler
Neurobiology and Behavior**	0425			R. Hoy
Physiology**	0410			R. Wasserman
*Communication Arts***	0601	D. Schwartz	D. Schwartz	N. Awa
*Education***	0801	J. Bail	G. Posner	K. Strike
Agricultural Education†	0899		W. Drake	
*Entomology***	0421	M. Tauber	E. Raffensperger	W. Tingey
*Floriculture and Ornamental Horticulture***	0109	C. Gortzig	K. Mudge	R. Langhans
Landscape Architecture**†	0204		M. Adleman	L. Mirin
*Food Science***	0113	J. Kinsella	J. Sherbon	R. Ledford
General Studies in Agriculture	0101		D. Burgett	
International Agriculture**			L. Zuidema	J. Metz
*Microbiology***	0411	R. Mortlock	P. VanDemark	P. VanDemark
*Natural Resources***	0115	H. Everhart	R. Morrow	R. Oglesby
Aquatic Science	0107		R. Oglesby	
Nutrition* (Div. Nutr. Sci.)		M. Nesheim, dir.	M. Devine	L. Wright
Plant Sciences, General	0402		P. Arneson	
*Plant Breeding***	0116	W. Pardee	C. Lowe	V. Gracen
*Plant Pathology***	0404	W. Fry	J. Lorbeer	M. Zaitlin
Plant Protection**			P. Arneson	P. Arneson
*Pomology***	0108	W. Kender	L. Creasy	F. Liu
*Vegetable Crops***	0108	R. Sweet	W. Kelly	P. Minotti
Rural Sociology	2208	E. Erickson	E. Erickson	
Development Sociology*				F. Young
*Statistics and Biometry***	0419	W. Federer	W. Federer	S. Searle

* = Graduate only
** = Graduate and undergraduate
† = Certificate/license

Degree Programs

The College of Agriculture and Life Sciences offers programs leading to the degrees of Bachelor of Science, Master of Science, and Doctor of Philosophy as well as several professional degrees including the Master of Professional Studies and the Master of Arts in Teaching, and some registered professional licensing or certification programs.

Graduate study is organized under graduate fields that generally coincide with the departments. Graduate degree requirements are described in the *Announcement of the Graduate School*. Degree programs offered in the college are listed above.

The Bachelor of Science Degree

To qualify for the Bachelor of Science degree, students must fulfill requirements established by the faculty of the College of Agriculture and Life Sciences and administered through the Office of Instruction.

Summary of Basic College Requirements for Graduation

1. Minimum number of credit hours: 120

2. Residence: Eight full-time terms of residence are normally required to complete the program of study.

A maximum of 15 credits per semester may be transferred for full-time attendance at another college, but at least 60 credits must be taken at Cornell. The intra-University transfer student must complete a minimum of two semesters in CALS and complete 30 credits, at least 20 of which must be earned in courses taught in CALS.

A student must enroll for and satisfactorily complete a minimum of 12 credits a term to remain in good standing. The typical program is 15 credits a term for eight semesters.

3. Distribution: 45 credits. A minimum of 9 credits are to be selected in each of the following four groups, plus 9 credits to be selected from any combination of these groups for a total of 45 credits. All courses must be taken for a letter grade.

Group A: Physical Sciences

Select at least two subjects, including 6 credits in one of the first three areas:

a. Chemistry
b. Mathematics: includes ALS 115; excludes Mathematics 109
c. Physics: except 201–205
d. Other: Agricultural Engineering 208–209; Astronomy 101–102, 103–104; Atmospheric Sciences 101, 202; Geology: 100 level only.

Group B: Biological Sciences

Select at least two subjects, including 6 credits in the first area:

a. Introductory biological science
b. Any course in the Division of Biological Sciences except Biology 108, 201–202, 205–206.
c. Other: Animal Sciences 200, 220, 221; Chemistry 251–253, 357–358; Entomology 212; Microbiology except Microbiology 100; Plant Breeding 225

Group C: Social Sciences and Humanities

Select 100-, 200-, or 300-level courses in at least two subjects. A list of courses in various subjects approved by the faculty is available in 192 Roberts Hall.

a. *Social Sciences:* Anthropology, Economics, Government, History, Psychology, Sociology
b. *Humanities:* Art, Languages, Literature, Music, Philosophy, Theatre

Group D: Written and Oral Expression

Select at least 6 credits in written expression and one course in either oral or written expression.

a. Freshman seminars
b. Africana Studies 137–138
c. Communication Arts 114, 301–302, 314, 316, 413; English 280–281, 288–289
d. Education 403

The basic competencies and skills needed for the various courses of study are usually acquired through selected courses that fulfill the distribution requirements. Students should consult with their faculty adviser to be sure necessary prerequisite courses are selected for the specialization. Generally speaking, the distribution requirements should be largely completed in the first two years of study, with courses in the specialization concentrated in the upper division.

4. Mathematics: A minimum competency in the fundamentals of mathematics is a requisite to satisfactory pursuit of a degree. Hence, the faculty of the college requires that all CALS students complete with a passing grade one course in mathematics as part of the Physical Sciences, Group A, distribution requirement. If advanced placement credit in mathematics or transfer credit in a college-level calculus course is presented, the requirement in Group A is waived.

a. The CALS Mathematics Placement Test index score is used to determine competency and help students select appropriate college mathematics courses. The test is administered just before registration each semester.

All *entering* undergraduates *except* those presenting advanced placement credit or transfer credit in college calculus are required to take the placement test. The test may *not* be repeated by any student. The placement test consists of fifty questions sampled from arithmetic, algebra, geometry, trigonometry, and a smattering of calculus. The index score is determined by the number of correct answers minus one quarter of the number of incorrect answers.

If a high index score (currently, equal to or greater than 30) is attained, the mathematics requirement in Group A is waived. If a low index score (currently, equal to or less than 12) is attained, the student should enroll in ALS 005 before selecting a mathematics course for Group A.

b. When presenting mathematics transfer credit in Group A, the student may

1) Include precalculus credits along with the calculus credits
2) Transfer up to 6 credits, *if* the index score is 30 or above
3) *Not* transfer any credit to Group A *if* the index score is from 13 to 30. (Credit may, however, be counted toward graduation.)
4) *Not* transfer any credit in mathematics *if* the index score is below 13.

The mathematics requirement should be completed at least by the end of the sophomore year or, for transfer students, by the end of the first year in residence. It is the responsibility of the student to plan a program of study in consultation with the faculty adviser that meets the college requirement in mathematics and that will provide adequate prerequisites in the area of specialization.

5. Electives: 75 credits. A minimum of 45 credits must be selected from courses offered in CALS, and another 10 credits must be in the statutory units, including CALS. Electives should be used to meet requirements of the program area and specialization. Core and sequence courses for the various programs of study are described on page 29. The remaining 20 credits needed to complete the graduation requirements may be taken in any college, including CALS. Students who exceed 20 credits in the endowed division will be charged excess tuition at the set rate per credit (currently, $189.0625).

6. Grade-point average (GPA): A cumulative GPA and last-term average of 1.7 or above must be maintained. Only grades earned at Cornell and while registered in CALS are included in the cumulative average. A student who fails to obtain the minimum cumulative average of 1.7 or a final-term average of 1.7 and who wishes to qualify for the B.S. degree must complete, with an average of at least 1.7, a minimum of 6 credits in Cornell Summer Session or a minimum of 12 credits in a regular term in the college. To graduate in fewer than eight terms, a cumulative average of at least 2.0 is required.

7. Physical Education: Completion of the University requirement (see p. 21). Transfer students receive credit toward this requirement for as many terms as they have been enrolled full time in another institution. Requests for postponement or exemption should be made in writing to the University Faculty Committee on Physical Education. Questions should be referred to Mr. Alan Gantert, Teagle Hall (telephone: 256-4286).

Students who have been in residence for eight semesters and who have met the graduation requirements will be graduated. Students are entitled to the full eight semesters even though they may have completed the graduation requirements. A student who wishes to continue study after graduation must apply for admission as a special student.

Academic Procedures and Policies

Procedures for University registration and course enrollment are described on page 19. To enroll in courses, CALS students pick up materials from the Scheduling Office, 192 Roberts Hall, plan a schedule of courses in consultation with their adviser, and return the completed forms to the Scheduling Office for verification and processing by the University computer system. Selection of specific laboratory or seminar sections must be verified in the Scheduling Office; class lists are generated on the basis of the properly filed course enrollment forms.

Three schedule cards—one for the student, one for the adviser, and one for the Scheduling Office—should be prepared.

Signature of the faculty adviser indicates approval of, or at least consent of, the choice of courses made and is required before the course enrollment can be processed.

To enroll in courses that involve independent study, teaching, or research, the student must complete an Independent Study Statement, available in 192 Roberts Hall, and submit it with the course schedule. Students who will be studying off-campus should file the Intent to Study Off-Campus form.

All students should construct a schedule which is appropriate and shows progress toward completing their specialization as well as the graduation requirements.

Off-Campus Study

Study off-campus is of two types: 1) credit may be earned at another institution and transferred to Cornell, or 2) credit may be earned in Cornell courses that require off-campus activity.

Programs in which students study off-campus but enroll for Cornell credit include SEA semester, field study in Human Ecology or I&LR, Albany semester, Washington experience, student teaching, IPM internship, and clinical microbiology internship. An Intent to Study Off-Campus form is available from the college registrar in 192 Roberts Hall. All students intending to receive Cornell credit for work done off-campus should file this form with the college registrar at the time of enrolling for courses to ensure that proper registration will occur. In some programs, adjustment in tuition is made to compensate for the reduced use of on-campus facilities.

Students who plan to enroll in courses at another institution in the United States or abroad, including those participating in the exchange program, petition to register for study in absentia. The petition form is available in the Office of Student Affairs, 17 Roberts Hall. The course of study that will be undertaken should be planned in consultation with the adviser to assure that the study is appropriate to the student's academic program. Approval of the petition by the Committee on Academic Achievement and Petitions guarantees acceptance of transfer credit as long as the grades received are equivalent to C or better. A maximum of 15 credits a term may be transferred for study in absentia.

Course Changes (Add/Drop/Change)

Students are held responsible for and receive a grade for those courses for which they enroll *unless they officially change such enrollment*. All changes in courses, credit hours, or grading option must be made *by the student* at the Scheduling Office, 192 Roberts Hall, on an official form provided for that purpose. When a student submits a properly signed Course Change form, the change is made on the official class lists by the Scheduling Office.

An official add/drop/change period is designated each term on the University calendar. CALS students may add courses during the first three weeks of the term and may drop courses until the end of the sixth week, after consultation and with approval of the adviser, by filing the properly signed forms in the Scheduling Office. Signatures are required to add or to drop a course.

Beginning with the seventh week of the semester, course changes are made only upon the approval of the Committee on Academic Achievements and Petitions. A special petition form for course changes is available in 192 Roberts Hall. Requests for course changes are approved only when the members of the committee are convinced that there are unusual circumstances that are clearly *beyond the control of the student*. The committee assumes that students should have been able to make decisions about course content, total work load, and scheduling prior to that time. Failure in a course is not considered an excuse for dropping it. If an illegal schedule results, petitions are generally denied unless very unusual circumstances are present.

Academic Achievement and Progress

The Committee on Academic Achievement and Petitions is a standing committee of six college faculty members and two students. On behalf of the faculty, and subject to its review, this committee

- Receives and acts upon petitions from individual students asking for exceptions from particular academic regulations or requirements of the college, or for reconsideration of action previously taken by the committee;
- Reviews at the end of each semester and at other times as shall seem appropriate to the committee, the progress of all students in meeting academic requirements;
- In case of students not making satisfactory progress, takes appropriate action, including, but not limited to, the following: issuing warnings to students, suspending them, decreeing that they may not reregister, granting them leaves of absences, and allowing them to withdraw;
- Acts upon readmission requests from persons whose previous enrollment was terminated by the committee;
- Notifies the petitioner in writing of the action taken by the committee and sends a copy of such notice to the student's adviser.

Academic Deficiency

The Committee on Academic Achievement and Petitions reviews the records of those students who in any respect are failing to meet the academic requirements of the college or who persistently fail to attend classes. In general terms, regular participation in course work with academic loads at a level sufficient to assure graduation within eight semesters and grades averaging C– or higher are *prima facie* evidence of satisfactory progress.

Specifically, the committee considers as possible cause for action, failure to attend and participate in courses on a regular basis or, at the end of each semester, failure to meet one or more of the following:

- semester quality-point average of at least 1.70
- cumulative quality-point average of at least 1.70
- passing 12 or more credits in academic subjects each semester
- normal progress toward meeting the University's requirement for physical education
- reasonable progress toward completion of distribution requirements and all other college and University requirements in eight semesters

Good academic standing means the student is eligible for, or has been allowed to register and to enroll in, academic course work for the semester. Whether an individual student is in good academic standing is determined by the College Committee on Academic Achievement and Petitions.

Petitioning Procedures

A student who feels he or she has grounds to be exempt from a college academic regulation may submit a petition. Petition forms are available in the college registrar's office and in the Office of Student Affairs.

A petition is usually prepared with the assistance of the student's adviser, whose signature is *required* to indicate awareness of the petition. The adviser's recommendation is helpful to the committee. The committee determines whether there is evidence of mitigating and unforeseen circumstances *beyond the control of the petitioner* that would warrant an exemption or other action. The adviser and the student are notified in writing of the committee decision.

Withdrawal

A student who finds it necessary to leave the University permanently should file a petition for withdrawal. Such petitions are approved if the student is in good standing. Students who have withdrawn and who later decide to return must apply to the Office of Admissions.

Graduation

The student who completes requirements for the degree will be graduated. In preparation for graduation, the student should complete the Candidacy for Baccalaureate Degree form in the college registrar's office. Diplomas are prepared by the Office of the University Registrar and distributed by the college registrar to those who have completed the degree requirements and have been approved by the college faculty. A copy of the final transcript, updated to include last-term courses, is mailed to the student by the University without charge.

Special Academic Opportunities

Honors Programs

The Bachelor of Science degree with honors will be conferred upon those students who, in addition to having completed the requirements for the degree of Bachelor of Science, have satisfactorily completed the honors program in their area of major interest and have been recommended for the degree by the honors committee of that area.

Undergraduates who wish to enroll in the honors program must have completed at least 55 credits, at least 30 of the 55 at Cornell. Also, the student must have attained a cumulative grade-point average of at least 3.00 at the time of entry. Interested students must make written application no later than the end of the third week of the first semester of the senior year, on the application form available from the college registrar, 192 Roberts Hall. The college registrar will verify the student's grade-point average and formally enroll the student in the program.

Academic credit may also be earned by enrolling in an appropriate independent study course. When applying for admission to the program, the student may, if appropriate, submit a budget and a modest request for funds to cover some of the costs the student incurs in doing the research.

The honors committee for each area recommends to the college registrar those students who qualify for honors. Only those who have maintained a GPA of at least 3.00 will be graduated with honors.

An honors program is offered in seven subject areas. The programs are described by area.

Animal Science

Faculty committee: W. R. Butler, chairman; J. M. Elliot, R. C. Gorewit

Program: Completion of the *honors program in animal science* requires the submission of a written report. This report is to be written in the style of a technical journal with one additional section, "Review of Literature". While it is expected that most students will undertake active research projects, a report totally devoted to review of literature may constitute a suitable project. When the report is submitted to the honors committee, it must be accompanied by supporting letters of evaluation from the faculty supervisor and at least one other faculty member. After reading the reports, the honors committee will interview each candidate regarding his project.

It is expected that the work required for honors will be above and beyond the requirements of any course, including Animal Science 499. However, it is anticipated that many projects may grow out of work initiated under Animal Science 499 or other courses. Since application to the program must be completed early in the senior year (two semesters before graduation), students are encouraged to make prior arrangements with faculty supervisors.

A detailed description of the animal science honors program and its requirements may be obtained from the committee chairperson.

Biological Sciences

Faculty committee: K. Beyenbach (animal physiology and anatomy), P. Bruns, (genetics and development), P. Hinkle (biochemistry, molecular and cell biology), H. Howland (neurobiology and behavior), D. Pimentel (ecology and systematics), H. Stinson, associate director (*ex officio*)

Program: Students will report on their research projects in two seminars and in an honors thesis that will be evaluated both by the committee and by two other faculty members. The students working in each section of the division will meet as a group during each semester together with the appropriate faculty member or members from the committee. These seminars must be attended by all students in the honors program. Active participation in terms of questions or comments is expected.

The thesis should be written in the form of a research report in a leading journal in the disciplinary area of research. Unless there are unusual circumstances, the thesis should not exceed twenty typewritten pages, double-spaced. The student, with guidance of the research supervisor, conducts a thorough literature search on the topic.

Three copies of the thesis need to be submitted to the honors committee by the designated date. The faculty research supervisor must submit an evaluation of the thesis, including judgments on the significance of the problem and of the thesis. The thesis is also reviewed by two anonymous faculty members. A majority vote of the honors committee that the thesis is acceptable is necessary for the recommendation that the student be graduated with honors.

Entomology

Faculty committee: E. W. Cupp, chairman; C. O. Berg, H. H. Hagedorn, R. A. Morse, D. Pimentel

Program: An *honors program in entomology* may be pursued by any qualified student in CALS. The student need not be specializing in entomology. Insects, because of their variety, small size, and easy availability, are convenient subjects for study in a wide array of problems dealing with living systems. Short life cycles, species with easily managed colony requirements, and a wide range of behavioral traits provide the raw material for honors study. Cornell's diverse faculty interests and extensive library in entomology are also a major asset if one selects entomology as the area for honors study.

The honors committee requires that an undergraduate who is interested in embarking upon an honors project proceed with the following steps:

- Discuss the matter with his or her academic adviser to determine if time and effort can be allotted to such an undertaking.
- Discuss the project with an appropriate faculty member in the area of entomology. (The faculty adviser will be of assistance in determining which faculty entomologist might be the best to approach, the decision being based primarily upon the subject-matter expertise of the available faculty.)
- Prepare a brief, tentative plan of the project for discussion with, and approval of, the honors project adviser. This plan should include a determination of support needed in such matters as space, equipment, time, and supplies. (CALS provides modest funds in support of projects upon application and submission of a budget proposal.)
- Present a completed application to the chairman of the entomology honors committee no later than the end of the third week of the first semester of the senior year.
- Submit a brief progress report, approved by the project adviser, to the entomology honors committee by midterm of the semester in which the student will complete his or her graduation requirements.
- Present a final project report that is approved by the faculty honors project adviser to the chairman of the entomology area honors committee no later than the last day of classes in the semester in which the student anticipates graduation.

Natural Resources

Faculty committee: M. E. Richmond, chairman; J. W. Kelley, R. J. McNeil

Program: The *honors program in natural resources* provides an opportunity for undergraduates to participate in independent research in the areas of fisheries and aquatic science, forest science, wildlife science, and conservation. The subject matter and nature of the research experience may be quite varied in this program but requires the guidance and supervision of a faculty member with substantial interest or expertise in the problem area chosen.

In addition to meeting requirements of the college we expect the student to do the following:

- Register for the honors program in the junior year.
- Select a faculty adviser who will help identify and formulate a research problem.
- Carry out independent research effort that is original and separate from the work of others who may be investigating similar subjects.
- Describe and summarize the work in the format of a conventional master's thesis or in the form of a

scientific paper ready for journal submission. (About half of our theses have been published.) Work closely with at least two faculty or staff who will agree to serve as readers for the thesis. Provide readers with a copy of the guidelines for evaluation of honors theses, available from the department's honors program committee.

Physical Sciences

Faculty committee: W. F. Shipe, chairman; D. A. Haith, D. J. Lathwell

Program: The *honors program in physical science* provides outstanding students with an opportunity to do independent research under the supervision of a faculty member in the Departments of Agricultural Engineering, Agronomy, and Food Science. Students must be enrolled in the program for a minimum of two semesters. They must also enroll in the appropriate departmental independent study course for a total of at least 6 credits.

Students must submit a report of their research to the honors committee at least four weeks before the end of instruction in the semester in which they expect to graduate.

Details of the program can be obtained from the chairperson of the physical science honors committee.

Plant Sciences

Faculty committee: E. A. Delwiche, chairman; C. C. Lowe, R. L. Obendorf, W. C. Kelly, R. P. Korf

Program: Completion of the *honors program in plant sciences* requires two copies of a report of independent research in the honors program to be submitted to the chairperson of the honors committee.

The report should be written in the format for research publication required by that discipline of plant science in which the student is enrolled. The report should be accompanied by a letter of recommendation from the supervisor of the research, that letter reflecting the supervisor's familiarity with the research, and including an evaluation of the performance and a recommendation for graduation with honors.

The honors committee will review the report and, if a majority of the committee votes favorably, the chairperson will recommend graduation with honors for that student in a letter to the director of instruction.

One copy of the report will be returned to the student; the other will be shelved in Mann Library.

Social Sciences

Faculty committee: D. Goodrich, P. Garrett, J. Lawrence, V. Rockcastle

Program: Honors degrees are awarded in the *behavioral and social sciences* upon approval of an honors thesis reporting a piece of original research in an appropriate area.

The research should deal with a substantive issue within one of the fields in the behavioral and social sciences. Both the results of the research, and the methodology or the argument by which the results were achieved, must be reported. Reviews of literature, practical conclusions or applications, or broad characterizations of an area of inquiry may constitute part of the research report but are not themselves sufficient to count as research. While work may originate in prior class work, it is expected that it will extend it. Students may, however, register for independent study in conjuction with an honors project.

Reports may be written according to the form of any standard journal within the appropriate fields. Three copies of the report should be submitted to the chairperson of the honors committee two weeks before the last day of classes of the semester for which the degree is sought. A supporting letter from the faculty member supervising the work must also be submitted. Approval of the thesis requires a majority vote of the honors committee.

Overseas Academic Programs

Several opportunities for study abroad are coordinated with the College of Agriculture and Life Sciences. These opportunities offer students a broadened educational program, a multicultural perspective, and possible new avenues of career development. Among the available study-abroad programs are two student exchange programs with universities in Mexico and Sweden. Cooperative arrangements with the University of Reading in England and the University of Dublin in Ireland have enabled the college to endorse several students for a year of study under a tutor in those schools.

Students interested in these or other year-abroad programs may obtain additional information from the Office of Student Affairs. *Students in the exchange programs must petition for registration in absentia.* Credit received for academic work at any of these schools may then be transferred to meet graduation requirements at Cornell in the normal time period.

Mexican exchange program. Two students from the college are competitively selected in the freshman year to go to the Instituto Tecnologico y de Estudios Superiores de Monterrey during the junior year. The sophomore year is used to attain proficiency in the Spanish language. Two students from Monterrey attend Cornell University under similar arrangements each year.

Swedish exchange program. The student selected to participate in the Swedish exchange program applies for it in the sophomore year and spends the junior year at the Agricultural College of Sweden at Uppsala. All essential expenses in Sweden, including a living allowance, are provided by a student group there. Round-trip air transportation must be paid by the student. An exchange student from the Agricultural College in Uppsala spends a year at Cornell University partially supported by the college and student groups here.

Year abroad in England. The college has an arrangement with the University of Reading whereby a few students are recommended to the faculty for admission for one year as occasional students. Students go in their junior year. All expenses are paid by the student, but total costs (including transportation) have been less than at Cornell.

Year abroad in Ireland. For college students with majors in the biological sciences or related areas, a special year-abroad program has been established with the University of Dublin (Trinity College) in Ireland. A small number of Cornell students in genetics, microbiology, and biochemistry participate in the program each year. The program is similar to the Reading program with respect to finances.

Major Fields of Study

The college curriculum emphasizes the biological and physical sciences and the technology basic to the study of agriculture and the life sciences. The variety of programs offered is in keeping with its mission "to increase our understanding of natural processes in the areas of agricultural sciences, biology, and the use of natural resources and the environment; to educate citizens for activity and leadership in these areas; and to translate new knowledge into action for the well-being of the people, their agriculture, their resources, and the communities in which they live."

Every curriculum creditable toward a degree in the college is registered with the State Education Board and is linked with the national Higher Education General Information Survey (HEGIS) codes for federal and state reporting. Graduate study is organized by fields, which may draw faculty from several disciplines and departments in the colleges of the University. Major and minor subjects offered in each field are described in the *Announcement of the Graduate School*.

In 1973, to facilitate the student's choice of a major field of study, the many undergraduate options and specializations offered by CALS were organized into eight broad but relatively homogeneous program areas: agricultural and biological engineering, animal science, applied economics and business management, behavioral and social sciences, biological sciences, environmental studies, food science, and plant sciences. A ninth area includes a cluster of special programs.

Faculty curriculum committees in each program area identify a core sequence of courses appropriate to all students in that field. The program area may be based in one department, or faculty from several departments may constitute the committee planning the sequence.

The program areas reflect the major academic effort in the college. Within each area, courses of study are designed to provide systematic development of basic skills and concepts and the opportunity for specialization in an area of particular interest to the student.

Programs are planned with considerable flexibility, allowing students to prepare for careers, further graduate work, professional opportunities, and the responsibilities of educated citizens. Course requirements in each program area are different, but all students must meet minimum distribution requirements of the college. Specific requirements are detailed in each program area.

Agricultural and Biological Engineering

Agricultural and biological engineering links, technology and engineering with the biological, social, and agricultural sciences. It is the branch of engineering that serves agriculture, directly concerned with the means for providing food and fiber to fill the basic needs of all people. The challenge in agricultural engineering is to develop systems that increase production of food while maintaining the quality of the environment and minimizing energy use.

Students study topics such as machinery, soil and water conservation, waste management, power and energy, structures and building design, bioengineering, community development, food engineering, construction and design of secondary roads, the teaching of agricultural mechanization, and environmental quality control.

The program is offered by the Department of Agricultural Engineering. It is housed in Riley-Robb Hall, which has one of the most complete agricultural engineering facilities in the United States.

Agricultural engineering is intended for the student who is particularly interested in the theoretical and fundamental aspects of engineering required for design and research. The student must have a strong aptitude for mathematics and physical sciences, and high motivation. Biological, social, and agricultural sciences are integrated in this specialization, but the physical sciences predominate. The specialization is jointly sponsored by the New York State College of Agriculture and Life Sciences and the College of Engineering. The curriculum, described in the Engineering College section, is accredited by the Engineer's Council for Professional Development. Students double register in both colleges during their junior and senior years. The agricultural engineering specialization provides excellent preparation for a wide variety of jobs in most industries that serve agriculture. Qualified graduates may also continue

study in a Master of Engineering, Master of Science, or doctoral degree program.

Agricultural engineering technology offers the student opportunities to take courses in such areas as agronomy, agricultural economics, natural resources, and animal science as well as plant physiology, food science, genetics, and microbiology. The emphasis is on technical aspects of the production of food, feed, and fiber.

Some of the interest areas offered are the teaching of agricultural mechanization, power and machinery, soil and water management, and structures and the environment. Students may also prepare for work in cooperative extension.

Specific course requirements for agricultural engineering technology are:

A. Basic Subjects	*Hours*
1. Mathematics, including one semester of calculus	6
2. Chemistry	6
3. Physical sciences	
a) Physics (if no previous high school physics)	8
b) Application of physical sciences (Ag Eng 208, 209)	6
4. Oral communication	3
5. Technical skills	
a) Computer programming	3
b) Graphics	3
c) Surveying	3
d) Metal work or carpentry	2

B. Advanced and Applied Subjects	
1. Agricultural sciences	
a) Soils	4
b) Animal production	3
c) Plant production	3
d) Farm or business management	3
2. Agricultural engineering technology: five agricultural engineering courses at the 300 level or above	15

Environmental technology is directed toward students with applied science and mathematical interests who have concern for the quality of the environment and a desire to deal with environmental quality management problems from a technological perspective. The specialization combines basic training in physical and biological sciences, ecology, and environmental quality with a selection of courses oriented toward technical problem solving. A graduate from this area of specialization should have the ability to work with scientists and engineers in industry and governmental agencies on environmental planning, environmental impact studies, and pollution control or in sales, development, and research.

Special course requirements for environmental technology are:

A. Basic Subjects	*Hours*
1. Calculus (Math 111, 112, and if graduate study is proposed, Math 214, 215, 216, 218)	6–10
2. Chemistry	6–8
3. Physics	8
4. Computer programming	3
5. Microeconomics	3
6. Introductory environmental sciences	
a) Soil science	4
b) Natural resources	3
c) Microbiology	3
d) Ecology	3

B. Advanced and Applied Subjects	*Hours*
1. Technology	
a) Hydrology (Ag Eng 371)	2
b) Environmental pollution (Ag Eng 325)	3
c) Environmental systems analysis (Ag Eng 475)	3
2. Environmental sciences: three courses selected from biochemistry, limnology, microbiology, natural resources, soil and water conservation, or biometeorology	9
3. Social sciences: two courses selected from economics, government, law, or sociology	6
4. Environmental engineering: two engineering waste management courses at the 400 level or above	6

Animal Sciences

Students in this program area study the breeding, care, and production of dairy and beef cattle, horses, poultry, pigs, and sheep. Basic and biological sciences are applied to animal industries to increase the supply of food and other products by animals. The animal science program is offered jointly by the Departments of Animal Science and Poultry Science. It is housed in Morrison Hall with some facilities also in Rice Hall. The Animal Research and Teaching Center is located at Harford, New York.

Production courses are designed to provide some practical experience in animal production. Many species of animals are used for study and research, including dairy and beef cattle, horses, sheep, swine, chickens, turkeys, ducks, mink, dogs, rabbits, rats, hamsters, guinea pigs, goats, and turtles. The program has excellent facilities for housing animals, and modern, well-equipped laboratories and classrooms.

Students enroll in both basic and applied courses and, with their advisers, develop a curriculum that may include courses in animal nutrition, animal breeding and genetics, animal physiology, meat science, and dairy cattle, livestock, and poultry production. Students who want to enter veterinary college or graduate school take additional courses in chemistry, physics, biochemistry, microbiology, and mathematics.

Students can concentrate in animal production; animal breeding and genetics; meat science; animal physiology; and animal nutrition. In consultation with their advisers, students may select sequences of courses tailored to their own interests. Students may prepare for careers in animal production or as technicians. Students whose interests and abilities warrant it usually are urged to emphasize the basic physical and biological sciences. This emphasis provides preparation for graduate study, admission to veterinary college, or careers in teaching or research in the more specialized disciplines of animal science.

Students are required to complete a minimum of 24 credits in animal science. This includes 12 credits in basic courses, 6 credits in animal or poultry production, and 6 credits in advanced courses. Work experience is highly recommended.

Students preparing for graduate or advanced professional work in animal science should take upper-division courses in chemistry and biochemistry as well as animal science courses in cytogenetics or animal breeding, forages, meats, swine or sheep, dairy cattle, artificial insemination, lactation, nutrition, and endocrinology.

Applied Economics and Business Management

In applied economics and business management, students may choose several specializations and options. Courses in agricultural economics are supplemented by others in related areas such as economics, sociology, history, government, industrial and labor relations, hotel administration, consumer economics, animal science, plant sciences, natural resources, mathematics, and statistics.

Students with outstanding academic records may apply to coregister in the Graduate School of Business and Public Administration in their senior year. For information, contact the Admissions Office, 315 Malott Hall.

The program in applied economics and business management is based in the Department of Agricultural Economics and housed in Warren Hall. Agricultural economics provides a general program in the economics of the agricultural sector. It is an appropriate major for those students who want (1) to survey offerings in agricultural economics, such as management, marketing, economic development, and policy and resource economics; and (2) to prepare for graduate work in agricultural economics.

Business management and marketing applies the principles of economics and the tools of management to prepare students for careers in business. Special emphasis is given to developing decision-making skills and to the study of the structure and practices of business institutions. Market analysis, sales, banking, merchandising, and production management are fields for which students may prepare.

Farm business management and finance is intended for students with farm experience who are interested in farming or in preparing for work in farm management or farm finance, in cooperative extension, and in farm cooperatives.

Food-industry management is designed for students interested in management or sales positions with the processing, manufacturing, or distribution segments of the food industry.

Resource economics is an option for students interested in the application of the principles of eocnomics to problems, both public and private, involving natural and human resources. Public-affairs management integrates a wide range of subject areas designed to familiarize students with the nature of public affairs and managerial complexities created by the interaction of economic factors in social and political institutions.

The program includes six core courses in the Department of Agricultural Economics and additional courses in an optional area of concentration.

Behavioral and Social Sciences

The behavioral and social sciences (BASS) are concerned with people, their society, and their environment. Knowledge developed in agriculture and life sciences is translated into programs affecting people and the environment in which they live and work.

The program is offered by three departments in the College—Communication Arts, in Roberts Hall and Mann Hall; Education, in Stone Hall; and Rural Sociology, in Warren Hall.

Communication Arts

Everyone must relate to others through the process of communication. As society becomes more complex and diverse, there is an increasing need for individuals who can interpret and relate to the complexities of the society and its organizations.

Students in the Department of Communication Arts study communication theory and practice. As a result, they learn both the psychology of communication and the most effective means of adapting written, interpersonal, audio, and visual communication to their audiences. The curriculum is based on a strong foundation in agriculture and the life sciences, the social sciences, and the humanities.

Students elect one of three different sequences by the beginning of their junior year: public communication, publication, or interpersonal communication. Each sequence has a required core of five to seven courses, including Writing for the Mass Media, Theories of Human Communication, and Introduction to Mass Media. In addition, each student is required to take Oral Communication.

To prepare students for a career in a particular professional field, a concentration of at least 12 credits outside the department is required. This may be all in a single department or related courses in several departments. The concentration allows students to plan for specific professions such as positions in public information, agricultural journalism, and personnel development and training.

Students are strongly encouraged to seek practical communication experience through the campus media, part-time or summer employment, or an internship program. This would contribute to a portfolio of professional materials that is invaluable in obtaining a position in communication.

Public communication prepares students for careers as communication, information, or public relations specialists in the widest variety of settings. This would include agriculture, business, education, government, and community and social welfare organizations.

Required courses for this sequence are taken in communication planning and strategy, survey research, communication in organizations, and visual communication. In addition, there is a heavy emphasis on writing skills.

Publication provides an excellent background in writing for a variety of markets. Students can select courses to provide them with skills as editors and writers in virtually any field, for example, agricultural journalist, editor for organizational publications, or science or technical writer.

Required courses for this sequence are taken in writing, media law, publication design, and communication theory. In addition, students serve as staff members for the *Cornell Countryman* for one or two terms.

Interpersonal communication prepares students for careers working less with media and more directly with people, such as personnel management, training, human services, and a variety of sales and consulting positions.

Required courses for this sequence are taken in communication theory, survey research, and writing. Electives include such courses as small-group communication, listening, persuasion, intercultural communication, and organizational communication.

Detailed descriptions of the sequences and the guidelines for the selection of elective courses are available from the Department of Communication Arts, 307 Roberts Hall.

Education

The focus in the Department of Education is on how teaching and learning take place in school and nonschool settings, as well as the role of education in our society. Students study concepts and develop competencies necessary to analyze educational situations critically and to plan, implement, and evaluate changes in educational programs in an effort to increase understanding of the substance and process of education so that human potentialities can be realized.

Agricultural education is intended for students who have good academic ability, experience in agriculture, and an interest in youth and young adults who would like to study agriculture. The ability to work with and get along with people is essential. This is the only program in New York State leading to certification to teach agriculture in public schools. The agricultural subjects are agricultural business, agricultural mechanization, conservation, farm production and management, horse handling and care, ornamental horticulture, and small animal science. Candidates must complete an approved curriculum leading to the baccalaureate degree, including a supervised teaching experience. During their sophomore year, students who are interested should consult Professor W. Drake, 212 Stone Hall, for technical and pedagogical requirements. Permanent certification requires graduate study.

Also available is a program that does not provide teacher certification. Students completing this specialization often find positions in businesses or industries conducting education programs. Some may enter fifth-year teacher-preparation programs.

For the education specialization, each student, in consultation with an adviser, plans a program that includes:

- One introductory course, either The Art of Teaching, or Educational Studies.
- Two courses selected from educational psychology; sociology of education; and general, political, or social philosophy of education.
- Field experience under the direct supervision of the student's adviser (or some other supervisor).
- Twelve to 15 credits of electives chosen from upper-division courses in education. These courses allow students to concentrate on a particular area or pursue special interests.

By selecting a science, mathematics, or environmental education sequence, students prepare for positions in environmental centers, museums, school systems, governmental agencies, youth organizations, private conservation organizations, or industrial groups. Each student will take about 50 credits in basic science, including both the biological and the physical sciences.

Students develop competence communicating to audiences of varying ages in the public relations activities concerned with environmental quality and interpretation, and in transmitting ideas and reports through mass media.

Rural Sociology

Rural sociology trains students in the theory, methods, and applications of sociology in rural society, both domestic and international. Each student specializes in one of three areas: rural social organization and development, theory and policy, or methods and analysis. Such training provides a basis for sociology-related occupations and prepares undergraduates for more detailed graduate work in a number of rural development fields.

Each student must complete 24 credits of courses in rural sociology and a 3-credit course in statistics. Required rural sociology courses are: 100, Introduction to Sociology, or 101, Introduction to Rural Sociology; 105, Rural Sociology and World Development; 213, Introductory Research Methods; 356, Rural Society in America; and 404, Intermediate Sociological Theory.

Biological Sciences

The program of study in biology is offered by the Division of Biological Sciences. Students enroll in either the College of Agriculture and Life Sciences or the College of Arts and Sciences.

Areas of concentration include general biology, animal physiology and anatomy; biochemistry; botany; cell biology; ecology, systematics, and evolution; genetics and development; neurobiology and behavior; and an independent option. Programs of study are described under the Division of Biological Sciences, page 204.

Microbiology

Microbiology is a specialization based in the College of Agriculture and Life Sciences. The program provides training for technical positions in microbiology or preparation for graduate work in theoretical and applied microbiology.

Students may prepare for career options such as food microbiology or pharmaceutical and industrial microbiology, or pursue preprofessional veterinary, medical, and dental programs.

For a limited number of students who are selected for the clinical microbiology specialization, the senior year may be spent at Cornell Medical College and the New York Hospital or at another affiliate.

The course of study requires concurrent course work in chemistry, physics, and mathematics and is designed to fulfill the requirements for accreditation by the American Academy of Microbiology. Most students specializing in microbiology elect additional courses in the College of Veterinary Medicine. More information may be obtained from the Department of Microbiology, Stocking Hall.

Nutritional Sciences

The Division of Nutritional Sciences is an intercollege unit affiliated with the College of Human Ecology and the College of Agriculture and Life Sciences. Most students are admitted to the undergraduate nutrition major through the College of Human Ecology. Students in the College of Agriculture and Life Sciences who want to pursue a nutrition emphasis may plan a concentration in biological sciences, option B, or in general studies in agriculture. Other studies in CALS closely related to nutritional sciences include food science, food-industry management, animal sciences and nutrition, vegetable crops, and microbiology. For more information about the curriculum, see Division of Nutritional Sciences, page 314, or consult M. Devine, associate director for academic affairs in the division.

Environmental Studies

The study of the environment and man's interaction with it is a vigorous and challenging area. The strategy for developing reasonable solutions to environmental problems requires a strong base of scientific, ecological, and technical knowledge; the ability to understand the natural environment; and the ability to estimate the effect of man's interaction with the environment. New tools and techniques borrowed from all areas of science and technology are being applied to the solution of environmental problems. Areas of specialization in environmental studies are the agronomic sciences relating to the atmosphere and to soils, entomology, landscape architecture, and natural resources with emphasis in wildlife, forestry, and aquatic science. The specializations are based in the departments of Agronomy, in Emerson Hall; Entomology, in Comstock Hall; Floriculture and Ornamental Horticulture, in the Plant Sciences Building; and Natural Resources, in Fernow Hall.

Agronomy

Biometeorology provides students with the basic principles of meteorology and the knowledge needed to understand environmental problems related to field-crop production, soil management, and the atmosphere. The program includes practical and theoretical aspects of meteorology and climatology. Graduates should have the training necessary for employment as a meteorologist, to work in national agencies, state environmental groups, and private industry focusing on the interactions between the atmospheric environment and cultivated crops and livestock. The freshman and sophomore years of study include a year and a half of calculus and a year each of physics, chemistry, and biology. During the junior and senior years, students acquire background in plant physiology, ecology, agronomy, agricultural economics, and natural resources. To provide additional depth in the agricultural sciences, the program requires the student to elect additional courses in one of the following fields: animal science, entomology, floriculture and horticulture, plant pathology, pomology, and vegetable crops.

Soil science provides students with background in the basic principles of soil science and the capability of solving soil problems, taking into consideration the soil's use and environment. The program combines

basic training in physical and biological sciences along with a thorough background in agronomy.

Students take 15 credits in agronomy, 10 credits in the physical sciences, and 8 credits in the biological sciences.

Entomology

Entomology offers students an opportunity to adapt their area of specialization to any of a variety of interests. Many students in entomology anticipate graduate training and find a broad range of courses available to them. Others may discover many courses related to entomology in applied agriculture useful for the career they are planning.

Courses in basic and applied subjects are offered. A student emphasizing science takes three entomology courses that provide a general basis for future study: Insect Biology, Insect Morphology, and Introductory Insect Taxonomy. These courses are followed by two or more courses from different areas of emphasis within entomology. At the same time, students are required to build a strong background in the basic sciences.

Floriculture and Ornamental Horticulture

Landscape architecture, affiliated with the Department of Floriculture and Ornamental Horticulture, is cosponsored by the College of Architecture, Art, and Planning. The program offers a first professional degree curriculum in landscape architecture at both the undergraduate and graduate levels, as well as a graduate second professional degree curriculum.

Landscape architecture is a licensed profession in most states. In New York State both the practice of landscape architecture and the use of the title *landscape architect* are restricted by law. Qualifications for licensing include completion of a specified period of approved professional work experience and passing a comprehensive state licensing examination.

Bachelor of Science curriculum. The landscape architecture undergraduate curriculum is a four-year professional program leading to a Bachelor of Science degree. The program is accredited by the American Society of Landscape Architects and by the State Board for Landscape Architecture of the New York State Education Department.

The undergraduate curriculum in landscape architecture centers around a three-year sequence of design studio courses which begins in the fall semester of the sophomore year. Transfer applicants are considered for fall-term admission only. Because of the six-semester design studio requirement, they enter the program at the second-year level.

Core courses in conceptual design, plant materials, landscape history and theory, landscape planning, landscape materials and construction, planting design, graphics, and natural sciences are required throughout the four-year curriculum. Studio courses deal with the application of design methods and principles that reflect knowledge and appreciation of land, water, plants, and the built environment in planning and designing land areas for public and private use. Basic to the curriculum is concern for the creation of environments that meet complex social needs and are ecologically sound and aesthetically pleasing.

Requirements for specialization in landscape architecture include satisfactory completion of the 61-credit core curriculum and an approved summer internship.

Curriculum

First Year—Fall Term	*Credits*
*LA 220, Principles of Landscape Architecture	2
†Arch 141, History of Architecture I	3
†Bio S 109, Biology for Nonmajors	3
†Math 103, Mathematics for Architects	3
†Freshman humanities elective	3
	14

First Year—Spring Term	
†Arch 142, History of Architecture II	3
†Bio S 110, Biology for Nonmajors	3
†Distribution elective in mathematics	3
†Freshman humanities elective	3
†Distribution elective	3
	15

Second Year—Fall Term	
*LA 201, Design I: Basic Landscape Architectural Design	5
*LA 205, Graphic Communication	3
†Bio S 260, Introductory Ecology	3
‡CRP 462, The American Planning Tradition	4
	15

Second Year—Spring Term	
*LA 202, Design II: Basic Landscape Architectural Design	5
*LA 224, Plants and Design	3
*LA 310, Site Construction I	4
†C Arts 301, Oral Communication	3
	15

Third Year—Fall Term	
*LA 301, Design III: Intermediate Landscape Architectural Design	5
*LA 311, Site Construction II	4
*LA 521, History of Landscape Architecture I	3
*Flor 313, Woody Plant Materials for Landscape Use	3
	15

Third Year—Spring Term	
*LA 302, Design IV: Intermediate Landscape Architectural Design	5
*LA 522, History of Landscape Architecture II	3
†Geol 101, Introductory Geological Sciences	3
‡Nt Res 300, Natural Resources Inventories	3
†Distribution elective	3
	17

Fourth Year—Fall Term	
*LA 400, Senior Thesis Project Seminar	1
*LA 401, Design V: Advanced Landscape Architectural Design	5
*LA 421, Professional Practice Seminar	2
*Ag Ec 320, Business Law	3
‡LA 520, Contemporary Issues in Landscape Architecture	2
‡CEEA 687, Image Analysis I: Landforms	3
	16

Fourth Year—Spring Term	
*LA 402, Design VI: Senior Thesis Project	5
†Art H 378, American Architecture, the City, and American Thought	4
†Distribution elective	3
‡Free elective	3
	15

Summary of credit requirements:	
*Specialization requirements	61
†Distribution electives	45
‡Free electives (minimum)	14
	120

Master of Landscape Architecture (M.L.A.) degree: first professional degree curriculum. The three-year M.L.A. curriculum is organized to prepare a student for professional practice in landscape architecture and is structured to provide a first professional degree for students with bachelor's degrees in areas other than landscape architecture or architecture.

Through a course sequence intended to develop basic landscape architectural skills and concepts, the three-year curriculum provides opportunities for students from diverse educational backgrounds to become proficient in landscape design, site construction, graphic communication, plant materials, and other related subject areas necessary to enter the profession fully qualified at the master's level.

Requirements of the three-year M.L.A. curriculum include 90 credits, satisfactory completion of the core curriculum courses, an approved summer internship, and a thesis or final project.

Curriculum

First Year—Fall Term	*Credits*
*LA 501, Graduate Landscape Architectural Design I	5
*LA 205, Graphic Communication	3
*LA 220, Principles of Landscape Architecture	2
*LA 520, Contemporary Issues in Landscape Architecture	2
‡Bio S 260, Introductory Ecology	3
	15

First Year—Spring Term	
*LA 502, Graduate Landscape Architectural Design II	5
*LA 310, Site Construction I	4
*LA 224, Plants and Design	3
‡Free elective	3
	15

Second Year—Fall Term	
*LA 601, Graduate Landscape Architectural Design III	5
*LA 311, Site Construction II	4
*LA 521, History of Landscape Architecture I	3
*LA 621, Summer Internship Seminar	2
*Flor 313, Woody Plant Materials for Landscape Use	3
	17

Second Year—Spring Term	
*LA 602, Graduate Landscape Architectural Design IV	5
*LA 522, History of Landscape Architecture II	3
*LA 622, Graduate Design Research Seminar	2
‡LA 532, Regional Landscape Planning II	3
‡Nt Res 300, Natural Resources Inventories	3
	16

Third Year—Fall Term	
*LA 701, Graduate Landscape Architectural Design V	5
*LA 421, Professional Practice Seminar	2
‡LA 531, Regional Landscape Planning I	3
‡Ag Ec 320, Business Law	3
‡CEEA 687, Image Analysis I: Landforms	3
	16

Third Year—Spring Term	
*LA 800, Master's Thesis in Landscape Architecture	9
‡Free elective	3
‡Free elective	3
	15

Summary of credit requirements:	
*Specialization requirements	70
‡Free electives (minimum)	27
	97

Master of Landscape Architecture (M.L.A.) degree: second professional degree curriculum. The two-year Master of Landscape Architecture (M.L.A.) curriculum serves to broaden and enrich undergraduate education in design by providing an expanded educational experience to those who are technically skilled. Applicants are therefore expected to hold a bachelor's degree in landscape architecture or architecture from an accredited institution.

The objectives of the two-year M.L.A. curriculum are to permit students to conduct research relating to landscape architecture and to provide advanced education and training to individuals who may wish to teach, practice, or conduct applied research in landscape architecture. Students are permitted considerable flexibility in establishing programs that

take full advantage of the teaching and research resources of the University.

Students admitted to the two-year M.L.A. curriculum are required to complete 60 credits of course work as approved by the members of their graduate committee. This must incude at least two advanced studios, a graduate seminar, and a thesis or final master's project.

Natural Resources

This undergraduate curriculum is designed to provide an enduring and broadly applicable education. A liberal education with a strong biological and natural resources base is emphasized. Students are provided an opportunity to understand the world around them and are exposed to ecological concepts that may form a principal basis for their future decisions and training.

The program is based in the Department of Natural Resources and is housed in Fernow Hall. The Arnot Forest Teaching and Research Center, a biological field-station laboratory within driving distance of the campus, has facilities for field-oriented courses, workshops, and opportunity for in-residence study at the Arnot Camp.

The curriculum helps prepare students for many useful endeavors and can serve as a base for graduate work in many fields. Students are prepared to appreciate and understand their natural environment and man's impact on it. A foundation is developed for the many students who continue with graduate professional training in natural resource conservation, wildlife science, fishery and aquatic sciences, and related resource programs.

Students are encouraged to study in each of the eight learning areas listed below:

1) Understanding basic substrates for life: geology, soils, meteorology, energy, ecology, and water resources.
2) Understanding natural processes: chemistry, physics, ecology, and field biology.
3) Understanding how organisms function: biology, physiology, anatomy, and behavior.
4) Understanding how people function: psychology, sociology, politics, government, history, anthropology, law, and economics.
5) Identifying and measuring the environment: taxonomy, resource inventory, and air photo interpretation.
6) Learning and developing basic life skills: communication, thinking, making decisions, logic, planning, philosophy, ethics, and others.
7) Learning special skills: mathematics, statistics, computer science, resource management, law, and so forth.
8) Learning about the world: students should recognize that not all learning takes place in the classroom. Exploring different careers, participating in campus and community activities, and independent research all contribute to continuing growth.

For students who wish to specialize further, natural resources offers a variety of options—wildlife science, forest science, aquatic science, and fishery science.

Students should seek relevant work experience to complement their academic studies.

Food Science

The food science program area is designed to provide students with basic skills and the knowledge necessary to ensure an adequate food supply. Students in this program take a core of fundamental courses and in consultation with faculty advisers select courses suitable for specific career objectives.

The core is designed to meet minimum guidelines of the Institute of Food Technologists, the professional society of United States food scientists. The student thus has an opportunity to become well prepared for a career in food science. The flexibility of the food science program allows students to prepare for a variety of positions in industry, government, or education. Some of the positions and areas of work require graduate training, and it can be useful in others as well. Opportunities for graduate study exist at a number of universities, including Cornell.

The program is offered by the Department of Food Science, housed in Stocking Hall. A full-scale dairy plant, and extensive laboratory facilities are available for training, research, and employment.

During the first two years, students take courses in biology, chemistry, physics, microbiology, and introductory food science, as well as make progress in meeting general college requirements. During the last two years, students take courses dealing with the application of science and technology to the processing, preservation, distribution, and utilization of foods.

Students are required to take Introductory Food Science, Introductory Nutrition, Food Analysis, Nutritional Aspects of Food Processing, Food Engineering, Sanitation and Public Health, Food Processing I and II, Food Chemistry, Sensory and Objective Evaluations of Foods, Food Microbiology, food chemistry laboratories, and introductory statistics.

Students may choose additional courses in chemistry, microbiology, or nutrition in preparation for careers in research and development; in mathematics and engineering for careers in processing and engineering; in marketing and business management; or in a variety of production courses related to specific commodities. Emphasis may be placed on the international aspects of food science.

Students are strongly encouraged to obtain further competence in one or more areas of emphasis. Lists of recommended courses are available for many areas, but the student is free to select courses for special objectives. The areas of emphasis include processing technology; food chemistry; nutritional aspects of processing; technology and management; dairy science; meat, poultry, and fish technology; food microbiology; and international food development.

Plant Sciences

Plant science students may specialize in general plant science, plant breeding, plant pathology, plant protection, field crops, floriculture and horticulture, pomology, and vegetable crops. Students with well-defined interests may specialize when they enter the college. Others can start in the general plant sciences curriculum and, if desired, specialize after the second year.

Study in the plant sciences is offered jointly by the Department of Agronomy in Emerson Hall, and the departments of Floriculture and Ornamental Horticulture, Plant Breeding, Plant Pathology, Pomology, and Vegetable Crops, all located in the Plant Sciences Building.

Agronomy

Field crops. Courses required for all students specializing in field crops (agronomy) include general biology, botany, plant physiology, general chemistry, organic chemistry, mathematics, crops, and soils. Students who anticipate a career in agricultural production or service after completion of the B.S. degree should take additional courses in crops, soils, crop physiology, agricultural economics, communications, plant pathology, entomology, nutrition, genetics, microbiology, and climatology. Students planning graduate or professional study beyond the bachelor's degree should take advanced course work in biochemistry; botany; qualitative, quantitative, and experimental chemistry; calculus; physics; and statistics.

Floriculture and Ornamental Horticulture

Horticultural science is applied to the production and marketing of florist, nursery, and turfgrass crops, and to the selection of plants for both the outdoor and interior landscapes, as well as to plant management in these environments. Students may specialize in greenhouse and nursery-crop production, turfgrass management, landscape contracting and maintenance service, retail and wholesale marketing of nursery and florist products and services, horticultural business management, and related areas. Environmental horticulture applies the science and art of horticulture to problems and solutions in the environment, to the development and implementation of environmental public policies, and to horticultural industries with direct interest in the environment. Many students choose to pursue a general program in floriculture and ornamental horticulture and include course work in all of these areas. Similarly, programs may be designed to prepare for teaching, cooperative extension, and communications careers in horticulture. Students wishing to prepare for graduate study in horticulture may develop a program in basic sciences and their application in horticultural science.

In consultation with the faculty adviser, each student tailors a program to achieve individual educational objectives in floriculture and ornamental horticulture. Students also are encouraged to take courses in these areas: agricultural economics and business management, agricultural engineering, agronomy (soils), ecology, entomology, plant pathology, plant physiology, oral and written expression, and plant taxonomy. Use of electives to pursue study in the humanities and in other areas of special interest to the student is encouraged and provides opportunities for broadening and enriching learning experiences. Numerous opportunities to become familiar with the horticultural industries and professions are provided through field trips, guest lecturers, and optional special problem and work experience programs.

General Plant Science

General plant science is intended for students whose interest in studying plants has not yet centered on any one of the more specialized groups within the area. Students may continue with this option throughout their undergraduate years, particularly if they are likely to be interested in, and qualified for, advanced studies beyond the bachelor's degree. Students who plan to seek employment upon graduation may prefer to specialize. There are, however, opportunities for general plant science graduates in the service and supply industries as extension agents, as teachers, and as research technicians.

More than a hundred courses are offered that deal directly with some area of plant science. Other courses relating to plant science are offered in agricultural meteorology, food science, and soil science. In addition, an interest in plant science can be combined with agricultural engineering, conservation, education, extension, marketing, statistics, international agriculture, or some other area of specialization.

Undergraduates are encouraged to obtain practical experience. This may involve research under the direction of a faculty member to work in a commercial industry, research institute, or on a farm. The Department of Plant Pathology will assist students looking for positions that would provide useful experience.

Plant Breeding

Plant breeding provides undergraduates with (1) preparation for graduate study leading to advanced degrees in plant breeding and plant genetics; and (2) preparation for work in producing and marketing of plant varieties and making varietal recommendations, and for positions in seed analysis, regulation, and quality control.

In cooperation with an adviser, each student plans a curriculum with a concentration in basic sciences supplemented by courses in applied fields best suited to his or her individual goals. Options for students to choose from include plant breeding and plant genetics; genetics, cytology, and cytogenetics; mathematics (calculus) and statistics; organic chemistry and biochemistry; plant anatomy, ecology, and physiology; crop production; and plant pathology and disease control.

Plant Pathology

Plant pathology requires broad training in the physical and biological sciences plus a general background in the area of crop production with emphasis on crop protection. Specific requirements depend upon the career the student is interested in, such as mycological or microbiological technician, biological research technician, technical representative for agricultural industry, cooperative extension agent, plant protection technician, or biology teacher. Students may also be interested in graduate work in plant pathology or some other area of biology.

A core of basic and applied courses is strongly suggested, including chemistry, mathematics, physics and biological sciences, plant breeding, and plant pathology. Courses chosen from agronomy, entomology, floriculture and ornamental horticulture, pomology, or vegetable crops complete the program.

Plant Protection

This specialization is offered for students who are interested in pest management for plant protection. The study of insects, diseases, weeds, vertebrate pests, and other factors that prevent maximum crop production may prepare students for careers in agribusiness, the agrichemical industry, cooperative extension, pest management consulting, state and federal regulatory work, and a variety of other technical positions. Although designed as a terminal program for students desiring a practical preparation in general plant protection, this specialization may also provide an adequate background for graduate work in entomology, plant pathology, or weed science.

The following subjects are considered essential to the plant protection specialization: botany and plant physiology, general ecology, soils, crop science, and microbial ecology. Additional courses in introductory entomology, insect pest management, introductory plant pathology, plant disease control, weed science, and pest management for plant protection are recommended. Students should plan to take a total of sixty-two to seventy credits in courses required and recommended for the specialization.

In addition, a number of other subjects pertinent to plant protection are recommended, depending upon the student's interests: agricultural economics, agricultural engineering, agronomy, biochemistry, communication arts, pathology and entomology, general physics, genetics, meteorology, mycology, pesticides in the environment, and plant anatomy. Employment between the junior and senior years involving practical experience in plant protection on a farm, at an experiment station, with an agrichemical company, or with a regulatory agency is encouraged.

Pomology

Pomology provides students a choice of two options: pomology or fruit production. While the two programs are quite similar, they are designed to meet the needs and interests of students preparing for two different lines of work. The pomology option is intended to provide students with somewhat more training in basic sciences in preparation for professional service with agencies concerned with fruit production, and further study at the graduate level. The fruit production option is intended to meet the needs of students planning to operate or manage fruit farms or to engage in similar work.

Recommended Courses	*Fruit Production Option*	*Pomology Option*
Pomology	20 credits	20 credits
Biological sciences	8 credits	14 credits
Entomology	6 credits	3 credits
Plant pathology	4 credits	4 credits
Agricultural economics	11 credits	
Agricultural engineering	5 credits	
Plant breeding	4 credits	4 credits
Chemistry, physics, and mathematics in addition to distribution requirements		20 credits

Vegetable Crops

Vegetable crops is one of the most diverse applied and scientific fields in agriculture. In New York more than twenty economically important vegetables are produced and marketed. Vegetable crops have a high value per acre, making it economically feasible to invest relatively large sums in land, equipment, fertilizers, seed, and pesticides. Many vegetables are highly perishable; consequently, considerable expenditure is made for refrigeration and special storage facilities as well as for packaging and handling techniques that have been specifically developed for each particular crop.

The opportunities for trained personnel are numerous in all aspects of vegetable production and the closely related fields of purchasing, processing, merchandising, extension, and banking. Some students may continue their studies in graduate school in preparation for teaching, research, or cooperative extension work in colleges and universities or in private industry. Recently there has been an increased interest in growing vegetables in tropical countries and in international agriculture; a specialization in vegetable crops provides excellent training for this vocation.

The different specialties in the area of vegetable crops afford a very flexible curriculum. Courses are chosen by the student in consultation with an adviser and other members of the staff. Students usually take most of the courses offered by the Department of Vegetable Crops and commonly choose other courses from accounting, agricultural geography, and marketing; soils, soil fertility, and regional agriculture; plant biology, physiology, ecology, and anatomy; oral expression; food sciences; nutritional sciences; plant genetics, statistics, and plant breeding; and economic entomology, plant diseases and their control, and weed science. Students supplement their course work with study in areas in which they have particular interest.

Special Programs and Career Options

Some students are interested in pursuing a broad general education in agriculture and the life sciences. Others are interested in pursuing a specialized interest, while still others are uncertain about their career objectives. Such students, in cooperation with their faculty advisers, plan a general studies sequence suited to their individual interests, abilities, and objectives. Independent study outside of existing program areas must be planned with a faculty adviser. Information on these options is available in the Office of Student Affairs, 17 Roberts Hall.

Cooperative Extension

Students may prepare for cooperative extension careers in agricultural production, 4-H youth development, community development, and homes and grounds education. With the help of designated advisers, courses selected will meet requirements for (1) preparation in agricultural technology in a department of the college, and (2) preparation in social sciences, communications, and program methodology. A limited number of cooperative extension agent positions are filled from each year's graduating class.

Students wanting to prepare for extension careers in commercial agriculture will complete a two-part requirement.

1) Each student must complete 15 credits or more in oral communication, written communication, psychology, and sociology with at least one course in each area. Freshman Seminars may not be used to fulfill the written communication requirement. It is strongly suggested that students also complete courses in education, particularly in curriculum development and adult education.
2) Students choose one of the specializations listed below and will work with the adviser to schedule their course work. Each student must complete the requirements for a specialization.

Specialization	*Adviser*
Animal science and dairy production	R. Warner
Farm business management and finance	G. Casler
Field crops and soil science	T. Scott
Floriculture and ornamental horticulture	G. Good
Pomology	G. Oberly
Vegetable crops	W. Kelly

Students who want to prepare for careers in 4-H program positions will complete part 1 as outlined above and are encouraged to concentrate on one or more areas of agricultural technology but not necessarily at the level required for a specialization. Advisers are assigned as follows:

Plant sciences	E. Schaufler
All other areas	G. Broadwell

General Studies in Agriculture

This specialization allows students to design courses of study suited to their individual interests, abilities, and objectives (1) for general education in agriculture or agricultural science, (2) for temporary classification to help them define vocational interests and goals, or (3) for independent study in a specialized field not encompassed by the existing program areas. For example, undergraduates in CALS may develop a nutritional sciences concentration through the general studies in agriculture. However, most undergraduates who major in nutrition are admitted through the College of Human Ecology. See page 314.

The general agriculture option includes production as well as technical courses in agriculture. Students, with help from their advisers, will select a range of agricultural electives to provide a broad background of agricultural experience. The minimum course and distribution requirements for general agriculture are those required of all students in the college. Advanced courses in the basic agricultural and life sciences are included. Students should contact the Office of Student Affairs for a list of advisers.

International Agriculture

International agriculture provides students with an understanding of the special problems of applying basic knowledge to the processes of agricultural modernization in low-income countries. The student typically specializes in a particular subject and works with an adviser to plan a program oriented toward international agriculture. The courses in international agriculture are designed to acquaint students with the socioeconomic factors in agricultural development, with the physical and biological nature of tropical crops and animals, and with various world areas for which study programs exist. The study of a foreign language is required.

In addition to the college distribution requirement of 45 credits, students majoring in international agriculture must take a minimum of 32 credits. A minimum of 5 credits in international agriculture and 8

credits in a modern foreign language are required. The other courses recommended are drawn from a wide range of disciplines. The objective is to acquaint students with the many facets of agricultural development in low-income countries. Students are encouraged to take additional specialized courses in one of the other program areas of the college. For additional information, students may contact L. W. Zuidema, at 256-3035.

Statistics and Biometry

Statistics is concerned with quantitative aspects of scientific investigation: design, measurement, summarization, and the making of inferences. Biometry is the application of mathematical and statistical techniques to the life sciences. Students with ability in mathematics and an interest in its applications will find this a challenging specialization.

The work of a statistician or biometrician can encompass research, teaching, consulting, and computing in almost any mix and in a wide variety of applications. Opportunities for employment are abundant in universities, in government, and in business and industry ranging from large corporations to small consulting firms, and salaries are usually excellent.

While satisfying course requirements for a specialization in statistics and biometry, students can also take a wide variety of courses in other disciplines. In fact, students are encouraged to take courses in applied disciplines such as agriculture, biology, economics, and the social sciences that involve numerical data and their interpretation.

Courses specifically required are Computer Science 100 (or Agricultural Engineering 304) and 211; Industrial and Labor Relations 310; Mathematics 191 or 111, 122 or 112 or 192, and 221–222 or 214–215–218; and Statistics and Biometry 200, 408–409, 416–417, 601–602, and 607. Recommended courses include Agricultural Economics 310; Agricultural Engineering 475; Computer Science 104, 107, 108, and 314; Mathematics 421–422 and 472; Operations Research and Industrial Engineering 320–321 or Agricultural Economics 412; Philosophy 231 or Mathematics 381; Statistics and Biometry 605, 606, and 662; and courses in quantitative methods in various disciplines. Work experience gained through summer employment or undergraduate teaching is highly recommended. Students may contact Professor W. Federer for information (telephone: 256-5488).

Teacher Preparation

For information about teacher preparation and certification to teach agricultural subjects, students should contact Professor W. Drake, Department of Education, 204 Stone Hall (telephone: 256-2197).

Description of Courses

Undergraduate and graduate courses in the college are offered through the seventeen academic departments and also through the Divisions of Biological Sciences and Nutritional Sciences.

Descriptions of courses, both undergraduate and graduate, are given by department, arranged in alphabetical order.

Graduate study is organized under graduate fields, which generally coincide with the departments. Graduate degree requirements are described in the *Announcement of the Graduate School*. Courses for graduate students are described in the section on the academic department that offers them.

Nondepartmental Courses

ALS 005 Basic Review Mathematics Fall or spring. 3 credits (this credit is not counted toward the 120 credits required for the degree). Primarily for entering students.
Fall: M W F 8 (two sections) or 12:20 (two sections). Spring: M W F 12:20 (two sections).
H. A. Geiselmann and staff.
Exposes students to some of the concepts necessary for success in other mathematics and science courses. Topics include exponents and radicals, conversion of units, algebraic fractions and factoring, solving equations in one or more unknowns, ratio, proportion and variation, percent and mixture problems. Considerable emphasis is placed on the analysis and reasoning involved in the solution of verbal problems requiring the use of mathematics.

ALS 027 Introduction to Farm Techniques Fall or spring. Noncredit. Grade does not appear on transcript. For permission to register, contact the Office of Career Planning and Placement, 16 Roberts Hall.
Fall: T or W 1:25–4:30. Spring: M T W R or F 1:25–4:30.
Classes meet at various college farm facilities.
W. F. Miller.
Provides supervised instruction in the basic manual skills of farming, including milking by hand and machine, handling livestock, and operating tractors and field equipment. General orientation to the practices and procedures of day-to-day farm operation.

ALS 100 American Indian Studies: An Introduction Fall. 3 credits.
Lec, T R 10:10–11:25; disc to be arranged.
R. Fougnier.
This course provides a foundation for the study of the American Indian. Emphasis will be placed on the social, cultural, historical, educational, and human development of the American Indian. Guest lecturers from Cornell staff and the Indian community will serve to broaden the scope of the course.

ALS 115 Introductory College Mathematics Fall or spring. 4 credits.
M W F 8, 9:05 (two sections), or 12:20 (two sections); lab, T 11:15 or 12:20, or R 11:15 or 12:20. Oct. 8, 8:30–10 p.m., Nov. 5, 8:30–10 p.m.; Nov. 23, 7–8 p.m.; Mar. 4, 8:30–10 p.m.; Apr. 8, 8:30–10 p.m.; Apr. 26, 7–8 p.m. H. A. Geiselmann, S. C. Piliero.
Designed to give students with sound high school mathematics backgrounds a unified treatment of the basic concepts of college algebra, analytic geometry, and the elements of calculus. Considerable emphasis is placed on the concept of function, graphing, problem solving, and methods of proof. The Cornell University Computing Language (PL/C) is taught and used to strengthen and integrate the mathematical topics covered.

ALS 400 Internship Fall, spring, summer. 6 credits maximum. Not open to students who have earned internship credits elsewhere or in previous terms. S-U grades only.
D. Allee and staff.
Students may register only for internships approved by the College Internship Committee. Currently, three opportunities are available: New York State Assembly Intern Program, New York State Senate Session Assistant's Program, and Albany Semester Program. A learning contract is negotiated between the student and the faculty supervisor stating conditions of the work assignment, supervision, and reporting. Participation is required in any structured learning activities associated with the internship.

ALS 401–402 American and World Community (also Government 401–402) 401, fall; 402, spring. 3 credits each term.
M W 7:30 p.m. One World Room, Anabel Taylor.
N. E. Awa, R. A. Baer, H. Feidman, J. C. Mbata, R. J. McNeil and others.
The theme of world community is examined in terms of the directions that the concept suggests, with special reference to the role of the United States in translating the concept to reality. The course seeks to examine the American experience against the background of world community from the points of view of the humanities, the social sciences, the natural sciences, and religious studies.

ALS 469 Agriculture, Society, and the Environment (also Biological Sciences 469) Spring. 3 credits.
Lecs, T R 12:20; disc W evenings and by arrangement. D. Pimentel and others.
This course, designed and conducted by Cornell students and staff, is aimed at interrelating the many facets of agriculture. The course stresses the importance of a holistic approach to agriculture by offering perspectives on many factors related to food production: soil fertility, plant breeding, pest control, ecosystems, world food problems, livestock production, energy, economics, social and political concerns, labor problems, and land and water management. This approach is used to develop the basic framework on which future options and strategies for food production in the United States and the world are examined and evaluated.

ALS 661 Environmental Biology (also Biological Sciences 661) Fall and spring. 1–3 credits. Prerequisite: permission of instructor.
Hours to be arranged. D. Pimentel.
Focuses on complex energy-environmental problems, using a multidisciplinary approach. Task forces of nine students, each group representing several disciplines, investigate significant energy-environmental problems. Each task force spends two semesters preparing a report for publication, modeled after National Academy of Sciences reports.

ALS 710 Nuturing Scientific Creativity Fall and spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. N. L. VanDemark.
A philosophical approach to issues relating to creative thinking and problem solving, with special emphasis on the human elements in scientist development, grantsmanship, project development, and research endeavors. Attention will be given to dealing with perceptual, emotional, cultural, and environmental blocks as well as educational, institutional, and governmental deterrents.

Agricultural Economics

O. D. Forker, chairman; D. J. Allee, B. L. Anderson, R. D. Aplin, R. Barker, S. L. Barraclough, N. L. Bills, D. Blandford, R. N. Boisvert, J. Brake, M. E. Brunk, J. B. Bugliari, D. L. Call, G. L. Casler, L. D. Chapman, G. J. Conneman, J. Conrad, L. M. Day, D. K. Freebairn, G. A. German, D. C. Goodrich, Jr., D. A. Grossman, L. L. Hall, R. B. How, R. J. Kalter, W. A. Knoblauch, E. L. LaDue, W. F. Lazarus, D. Lee, W. H. Lesser, J. F. Metz, Jr., R. A. Milligan, T. D. Mount, A. M. Novakovic, T. T. Poleman, K. L. Robinson, D. G. Sisler, R. S. Smith, B. F. Stanton, J. A. Sweeney, L. Tauer, W. G. Tomek, G. B. White

150 Economics of Agricultural Geography Fall. 3 credits.
Lecs, M W F 11:15 or 12:20. Prelims, R 7 p.m., Sept. 28 and Nov. 4. D. G. Sisler.
The economics and geography of world agriculture, providing a basis for understanding past development and future changes. Elementary economic principles, historical development, physical geography, and population growth are studied in their relation to agricultural development and the

economic problems of farmers. Where possible, current domestic and foreign agricultural issues are used to illustrate principles.

220 Introduction to Business Management Fall. 3 credits.
Lec, M W F 10:10; disc, M 12:20–2:15, 2:30–4:25, or 7:30–9:25 p.m.; T W 8–9:55, 10:10–12:05, 12:20–2:15, or 2:30–4:25. In weeks when discs are held, there will be no W lecture. Discs are held instead of a lecture in all but four weeks of the term. R. D. Aplin.
Principles and tools useful in performing four major functions of management: planning, organizing, directing and leading, and controlling. Within this framework, consideration is given to social, legal, and economic environments; forms of business ownership; financial statements; cost behavior; and a few key concepts and tools in financial management.

221 Accounting Spring. 3 credits. Not open to freshmen.
Lecs, M F 10:10; lab, T W or R 8–9:55, 10:10–12:05, 12:20–2:15, or 2:30–4:25. Two evening prelims. Staff.
A comprehensive introduction to financial accounting concepts and techniques, intended to provide a basic understanding of the accounting cycle and the elements of financial statement analysis and interpretation. Concepts rather than procedures are emphasized.

240 Marketing Spring. 3 credits.
Lecs, M W F 11:15; lab, M 2:30–4:25, T 12:20–2:15 or 2:30–4:25, W 2:30–4:25, R 12:20–2:15 or 2:30–4:25, or F 10:10–12:05. In weeks labs are held, there will be no F lecture. Staff.
An introductory study of the food marketing system and the society it serves, including the goals and practices of farmers and marketers (in such areas as buying and selling, grading, transporting, packaging, and advertising), price-making institutions (such as commodity futures markets), the behavior and purchasing practices of consumers, and the interrelationships among these groups.

250 Introduction to Energy Resources Spring. 3 credits.
Lecs, M W F 11:15. D. Chapman.
An introduction to the concepts of efficency, competitive equilibrium, and social cost. The course focuses on basic energy resources, examining production costs and demand for petroleum, natural gas, electricity, nuclear power, and solar energy. The ownership and regulatory structure of each energy industry is discussed, as well as selected policy issues such as price control, taxation, public ownership, conservation, and renewable resource use.

302 Farm Business Management Spring. 4 credits. Not open to freshmen. This course is a prerequisite for Agricultural Economics 402.
Lecs, M W F 10:10; lab, T W or R 1:25–4:25. On days farms are visited, the lab period is 1:25–5:30. One all-day trip and several half-day trips are taken to visit farm businesses. R. A. Milligan.
An intensive study of problems associated with planning, organizing, operating, and managing a farm business, with emphasis on the tools of managerial analysis and decision making. Topics include management information systems, business analysis, economic principles, and budgeting; and acquisition, organization, and management of capital, labor, land, and machinery.

310 Introductory Statistics Fall. 3 credits. Prerequisite: ALS 115 or equivalent level of algebra.
Lecs, M W F 12:20; lab, M 2:30 or 3:35, T 2:30 or 3:35 or W 2:30 or 3:35. Evening exams. D. MacLaren.
An introduction to statistical methods. Topics to be covered include the descriptive analysis of data, probability concepts and distributions, estimation and hypothesis testing, regression, correlation and time series analysis, and selected nonparametric methods. Applications from business, economics, and the biological sciences are used to illustrate the methods covered in the course.

320 Business Law Fall. 3 credits. Limited to upperclass students.
Lecs, M W F 9:05. One evening prelim. J. B. Bugliari, D. A. Grossman.
Consideration is given chiefly to legal problems of particular interest to persons who expect to engage in business. Emphasis is on personal property, contracts, agency, real property, and partnerships and corporations.

321 Business Law Fall. 4 credits. Limited to upperclass students. Prerequisite: permission of instructor.
Lecs, M W F 9:05; disc, M 4; one evening prelim. J. B. Bugliari, D. A. Grossman.
The lecture portion is the same as Agricultural Economics 320. Discussions deal with practical applications of the legal principles covered in that course and attempt also to give some deeper insight into the roles and functions of the lawyer and the judiciary in our society.

322 Taxation in Business and Personal Decision Making Spring. 3 credits. Recommended: background in accounting and business law.
Lecs, M W 2:30–4. J. B. Bugliari, D. A. Grossman.
The impact of taxation, both state and federal, on business and personal decision making. After a brief discussion of tax policy and state and local taxes, an in-depth examination is conducted of federal income and estate and gift taxes affecting individuals and business entities. Both tax management and tax reporting are stressed.

323 Managerial Accounting and Economics Fall. 3 credits. Prerequisites: Agricultural Economics 221 and Economics 102 or equivalents.
Lecs, M W 1:25; disc, R 10:10–12:05, 12:20–2:15, or 2:30–4:25, or F 10:10–12:05, 12:20–2:15, or 1:25–3:20. Two evening prelims. Staff.
An introduction to cost accounting that emphasizes the application of accounting and economic concepts to managerial control and decision making. Major topics include basic costing, standard costing, cost behavior, cost allocation, pricing, budgeting, inventory control, transfer pricing, measuring divisional performance, and accounting for inflation.

324 Financial Management Spring. 3 credits. Prerequisites: Agricultural Economics 220 or equivalent. Recommended: Agricultural Economics 221 or equivalent.
Lecs, M W F 9:05; disc, W 2:30–4:25, R 8–9:55 or 12:20–2:15, or F 9:05–11 or 12:20–2:15. In weeks when discs are held, there will be no F lecture. Discs are held instead of lecture in all but two weeks of the term. Two evening prelims. B. L. Anderson.
Focuses on three major questions facing management: how to evaluate capital investment decisions, how to raise the capital to finance those investments, and how to generate the sufficient cash flows to meet the firm's cash obligations. Major topics include methods to analyze capital decisions, impact of taxes, techniques for handling risk and uncertainty, effects of inflation, sources and costs of debt and equity, capital structure, leverage, and working capital management.

332 Economics of the Public Sector Spring. 3 credits. Prerequisite: Economics 102 or equivalent.
Lecs, M W F 11:15; disc, W 2:30–4 or 7:30–9 p.m., R 12:20–1:50, or F 12:20–1:50. Staff.
The application of economic concepts to evaluation of the structure and performance of the public sectors of the economy. Emphasis on microeconomic analysis of public finance and public resource allocation. Principal topics: market failure, articulation of public choice and interests, evaluation of public decisions, and current public policy.

340 Economics of Marketing Spring. 3 credits. Prerequisites: Economics 101–102 and Agricultural Economics 240 recommended.
Lecs, M W F 12:20–1:10. L. L. Hall.
This course provides an integrative framework for analysis of marketing functions, activities, and decisions in the food industry. Producer, consumer, and government behavior in the marketing system are explored, and their interaction is discussed. The course focuses on the importance of demand, the industrial organization of the food industry, and the causes and consequences of government intervention.

[342 Marketing Management Fall. 3 credits. Prerequisites: Agricultural Economics 240 and Economics 101–102. Not offered 1982–83.
Lecs, M W F 10:10; disc, R 12:20–2:15 or 2:30–4:25, F 8–9:55, 10:10–12:05, or 12:20–2:15. In weeks discs are held, there is no F lecture. D. C. Goodrich.
Deals with principles and practices in the firm's management of the marketing function. Emphasizes the revenue aspects of marketing by considering sales forecasting and strategies in product and brand selection, pricing, packaging, promotion, and channel selection. Identification and generation of economic data necessary for marketing decisions are considered]

346 Dairy Marketing Spring. 2 credits. Limited to juniors and seniors. Prerequisite: Economics 102.
Lecs, T R 8–9:30 (first 9 weeks). A. Novakovic.
A review of the structural characteristics of the dairy industry and an analysis of policy issues, pricing systems, and government programs, including marketing orders, price supports, and import policies.

347 Marketing Horticultural Products Fall. 3 credits. Prerequisite: Agricultural Economics 240 or equivalent.
T R 8:30–9:55. All-day field trip the last Saturday in September. R. B. How.
A study of markets, marketing channels, and marketing services for fruits, vegetables, and floricultural commodities. An evaluation of marketing alternatives facing growers, shippers, wholesalers, and retailers of horticultural products. The role of public agencies in market information and regulation. The potential for group action to improve marketing operations.

350 Resource Economics Fall. 3 credits. Prerequisite: either Natural Resources 201 and introductory economics or permission of instructor.
Lecs, T R 10:10; disc, M or T 1:25–3:20. Several field trips to be arranged. D. J. Allee.
The application of economic and political science concepts to the use of natural resources, with varying attention to water, land, forests, and fisheries. Considers regional growth, the impact of urban growth, and public decision making in the resources and environmental management area.

351 Farm and Food Policies Fall. 3 credits. S-U grades optional.
Lecs, T R 9:05; disc, R 11:15 or 1:25, or F 10:10. K. L. Robinson.
The course deals broadly with farm and food policies, including price support and storage or reserve policies, international food aid, agricultural protection, soil conservation, the structure of agriculture, and domestic food subsidy programs.

380 Independent Honors Research in Social Science Fall or spring. 1–6 credits. Limited to students who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program.

402 Advanced Farm Business Management Spring. 3 credits. Prerequisite: Agricultural Economics 302 or equivalent.
Lecs, M W 9:05; disc, W or R 1:25–3:20. G. L. Casler.
Emphasis is on evaluating the profitability of alternative investments and enterprises. Principal topics include the effects of income taxes on investment decisions, capital investment analysis, linear programming, and financial risk and uncertainty. Experience in computer applications to farm business management is provided.

405 Farm Finance Fall. 3 credits. Prerequisite: Agricultural Economics 302.
Lecs, T R 11:15; disc, W 1:25–3:20. E. L. LaDue.
The principles and practices used in financing farm businesses, from the perspectives of the farmer and the farm lender. Topics covered include sources of capital, financing entry into agriculture, financial analysis of a business, capital management, financial statements, credit instruments, loan analysis, financial risk, leasing, and the forms of business organization.

406 Farm and Rural Real Estate Appraisal Spring. 4 credits. Limited to 45 students. Prerequisites: Agricultural Economics 302 or equivalent *and* permission of instructor.
Lecs, T R 10:10; lab, R 1:25–4:25. On days farms are visited the laboratory period is 1:25–5:30. One all-day trip. Staff.
The basic concepts and principles involved in appraisal. Factors governing the price of farms and rural real estate and methods of valuation are studied. Practice in appraising farms and other rural properties.

407 Advanced Agricultural Finance Seminar Spring. 2 credits. Limited to 16 seniors with extensive course work in farm management and farm finance. Open by application prior to March 1 of the year before the course is offered.
W 3:35–5:30. E. L. LaDue.
A special program in agricultural finance conducted with financial support from the Farm Credit System. Includes two days at Farm Credit Banks of Springfield, one week in Farm Credit Association offices, an all-day field trip observing FHA financing during fall term, a four-day trip to financial institutions in New York City during intersession, and lecture-discussions in the spring term. Representatives from banking, agribusiness, finance, and similar areas participate in spring term lecture-discussion sessions.

408 Seminar in Farm Business Decision Making Intersession (1 week). 1 credit. Prerequisite: Agricultural Economics 302 and 405, and permission of instructor.
M T W R F 8–5. G. J. Conneman.
Develops method of analyzing farm business management problems. Gives student experience in identifying alternatives in problem solving. Provides opportunities to analyze and evaluate actual farm situations. Two field trips and intensive work with a farm family.

409 Farm Management Workshop Fall. 1 credit. Limited to seniors and graduate students.
T 12:20–2. B. F. Stanton and staff.
Presentation and interpretation of research in farm management and production economics. Each participant conducts a seminar and prepares a publishable evaluation of research results directed toward farmers and extension and business leaders.

410 Seminar in Farm Business Organization and Estate Planning Fall (first meeting, last Monday in September). 1 credit. Prerequisite: Agricultural Economics 302 and 405.
M 1:25–3:20. R. S. Smith.
Designed for seniors who plan to return to the home farm or to take positions working with commercial farmers in a finance or management capacity. Topics include choice of a business structure for family farm; organizing and operating a family partnership; initiating and managing a commercial farm corporation; financing, tax, and legal problems in starting, operating, and terminating a two-generation family business; estate-planning problems of farm-owning families. Class presentations are informal. Students solve case problems and prepare papers on their home farm or an assigned problem.

412 Introduction to Linear Programming Spring. 3 credits. Primarily for juniors, seniors, and M.S. degree candidates. Prerequisite: Agricultural Economics 310 or equivalent.
Lecs, M W 10:10; lab, W 1:25–3:20 or 3:35–5:20. B. F. Stanton.
An introduction to the concepts and computational procedures of linear programming. Emphasis on interpretation of results, model building, and data requirements for estimation using standard computer programs. Topics include sensitivity analysis, parametric programming, the transportation problem, scheduling, and distribution. Primary applications are made to agriculture and business.

415 Agricultural Prices Spring. 3 credits. S-U grades optional. Prerequisite: An introductory course in economics, such as Economics 101–102.
M W F 11:15. Staff.
An analysis of supply and demand characteristics of farm commodities, institutional aspects of pricing farm and food products, temporal and spatial price relationships, price forecasting, and the economic consequences of pricing decisions.

416 Price Analysis Spring. 2 credits. Prerequisites: Agricultural Economics 310 or equivalent and coregistration in Agricultural Economics 415.
Lec, M W 1:25. W. G. Tomek.
The course introduces students to procedures used in empirical studies of demand, supply, and price behavior for agricultural products. Multiple regresssion techniques are emphasized. Each student is required to specify, fit, and report on an empirical model.

420 Advanced Business Law Spring. 3 credits. Limited to upperclass students.
Lecs, T R 8:30–9:55. One evening prelim. J. B. Bugliari.
Designed to provide a fairly detailed and comprehensive legal background. Selected areas covered in Agricultural Economics 320 are further developed, and particular consideration is given to the law pertaining to bailments, sales, secured transactions, bankruptcy, and negotiable instruments.

421 Advanced Business Law Spring. 4 credits Limited to upperclass students. Prerequisite: permission of instructor.
Lecs, T R 8:30–9:55; disc, T 4. One evening prelim. J. B. Bugliari.
Lectures cover the same material as Agricultural Economics 420. The discussions cover aspects of estate planning: estate planning techniques, the law and use of trusts, the law of wills, and federal and New York State estate and gift taxes and probate procedures.

422 Estate Planning Spring. 1 credit. Limited to upperclass students. S-U grades only. Cannot be taken by students who are enrolled in or who have taken Agricultural Economics 421.
Lec, T 4. J. B. Bugliari.
Fourteen sessions on the various aspects of estate-planning techniques. The law and use of trusts, the law of wills, federal and New York State estate and gift taxes, and probate procedures are covered.

424 Business Policy Spring. 3 credits. Limited to seniors majoring in business management and marketing.
T R 9:05–10:35, 11:05–12:35, or 2:30–4. R. D. Aplin.
An integrating course that examines business policy formulation and execution from the standpoint of the general manager of an organization, focusing on decision making at the top management level. The course is built around a series of cases. Emphasizes improving oral and written communication skills.

425 Personal Financial Management Spring. 2 credits. Limited to juniors and seniors.
Lec, M 12:20–2:15; disc to be arranged. Second hour of lec is omitted in weeks discussions are held. D. A. Grossman.
Managing personal income to maximize financial goals and objectives. Topics covered include financial institutions, investment alternatives, insurance, retail credit, housing, income taxation, and estate planning. Discussions are devoted to problems and case studies in financial planning for students and young families.

426 Management of Cooperative Action Fall. 3 credits.
Lecs, M W F 11:15. Evening prelim. B. L. Anderson.
Investigates the unique aspects of cooperative business organizations. Topics are approached from the point of view of management, the board of directors and members, and include cooperative principles, management decision making, legislation, financing, taxation, and marketing problems cooperatives attempt to handle. Primary focus is on operating cooperatives in agriculture but also includes an examination of informal group action, bargaining cooperatives, marketing orders, and marketing boards.

430 Agricultural Trade Policy Fall. 3 credits. Primarily for seniors and M.S. degree candidates. Prerequisites: Agricultural Economics 351 and either Agricultural Economics 352 or Economics 311.
Lecs, T R 11:15; lec or disc, M or W 3:35. Evening prelim. D. MacLaren.
An examination of the rationale and method of commodity trade policy. The course analyzes problems and issues in both developed and less-developed countries and deals with the major questions associated with the organization of international commodity markets.

443 Food Industry Management Spring. 4 credits. Limited to juniors and seniors.
M W F 9:05 or 10:10, W 2–4. G. A. German.
A case-study approach is used to examine the application of management principles and concepts to operating problems of food retailers and whosesalers. Areas included are site selection, buying, merchandising, personnel administration, private-label products, and financing expansion programs. Leading food industry specialists frequently join the W session.

448 Food Merchandising Fall. 3 credits. Limited to juniors and seniors. Prerequisite: Agricultural Economics 240.
Lecs, T R 10:10; sec to be arranged. G. A. German.
Merchandising principles and practices as they apply to food industry situations. The various elements of merchandising are examined, including buying, pricing, advertising, promotion, display, store layout, profit planning and control, and merchandising strategy.

449 Field Study of Marketing Institutions Fall. 2 credits. Prerequisites: Agricultural Economics 342, previous enrollment or concurrent registration or permission of instructor. Field trips will cost approximately $175.
W 2:30–4. Two 1-day field trips to the upstate area and a 3-day trip to the New York City area during intersession just prior to registration. Grades are not registered until February. W. Lesser, B. Anderson.
Incorporates lectures, case problems, and field trips to give students a broad understanding of the

institutions and operations involved in distributing and marketing a cross section of agricultural products. Emphasis is on the marketing functions provided by firms in selected agricultural industries, their control and strategic practices, and relationships with other firms.

450 Evaluating Resource Investment and Environmental Quality Spring. 3 credits. Primarily for juniors and seniors. Prerequisite: an introductory course in economics, a 300-level agricultural economics course, or permission of instructor.
T R 10:10–11:30; disc to be arranged. D. J. Allee.
Means of reaching decisions on environmental questions. Concepts of social value and cost-benefit analysis, determination of degrees of importance of environmental problems, environmental impact statements, definitions of environmental quality, and questions of political economy.

452 Agricultural Land Policy Spring. 3 credits.
Lec, F 8–9:55; disc, F 1:25–3:25; field trips to be arranged. R. J. Kalter.
Recent changes in the laws, programs, and policies at state and local levels that affect the use of farmland in the northeastern United States.

464 Economics of Agricultural Development Spring. 4 credits. Prerequisites: Agricultural Economics 150, Economics 101–102, or permission of instructor.
T R 9:05 and T or W 1:25. D. K. Freebairn.
An examination of the processes of agricultural development in Third World nations and their interactions with United States policy. Agricultural and rural development policy, the interdependence of agriculture with other sectors, alternative forms of agricultural organization, and policies tending to alleviate highly concentrated income distributions are all emphasized.

499 Undergraduate Research Fall or spring. 1–4 credits. Limited to seniors with grade point averages of at least 2.7. Prerequisite: written permission of the staff member who will supervise the work and assign the grade; this permission must be attached to course enrollment material. S-U grades optional.
Permits outstanding undergraduates to carry out independent study of suitable problems under appropriate supervision.

608 Production Economics Fall. 3 credits. Prerequisite: Economics 311 or equivalent. Recommended: Mathematics 108 or 111 or equivalent.
Lecs, M W F 10:10. L. W. Tauer.
The theory of production economics with emphasis on applications to agriculture. Topics include the derivation, estimation, and use of production, cost, and supply functions. Production response over time and under risk is introduced.

650 Economic Analysis of Public Policy Spring. 4 credits. Primarily for graduate students but open to seniors. Prerequisite: Economics 509, or permission of instructor.
T R 9:05–11. R. J. Kalter.
The application of economic theory and analysis to governmental decision making, budgeting, and expenditure processes, with emphasis on the welfare criteria of economic efficiency and income distribution. Techniques of benefit-cost, equity, and environmental analysis will be stressed. Discount rates, benefit estimation, externalities, multipliers, uncertainty and social welfare functions will be covered.

651 Economics of Resource Use Fall. 4 credits
Lec-sem, F 1:30–4:30. D. Chapman, J. Conrad, T. Mount.
An introduction to recent literature in theory and applied analysis. Dynamic optimization and resource use, externality theory and its application to environmental economics, pricing and taxation, and resource use, income, and employment. Other topics as selected by class and instructors.

652 Special Problems in Land Economics Fall or spring. 1 or more credits. Limited to graduate students. Prerequisite: permission of instructor.
Hours to be arranged. D. J. Allee.
Special work on any subject in the field of land economics.

660 Food, Population, and Employment Fall. 5 credits. Enrollment limited to 15 to ensure that students have an opportunity to work individually with instructor.
M W 2:30–4 and an individual weekly meeting with the instructor. T. T. Poleman.
Examines the links between employment, food, and population growth in less-developed countries. Food economics and the world food situation are treated as cornerstones and examined in historical perspective. Requires a major term paper.

661 Food, Population, and Employment II Spring.1–3 credits. Prerequisite: permission of instructor.
Individual weekly meeting with the instructor.
T. T. Poleman.
Individual, guided research for students who want to carry on with projects initiated in Agricultural Economics 660 or to undertake new ones.

663 Macroeconomic Issues in Agricultural Development Fall. 3 credits. Prerequisite: permission of instructor. Offered alternate years.
Lec to be arranged. E. Thorbecke.
Issues such as role of agriculture in economic development, agricultural sector analysis; income price and technological interactions within and between agriculture and other sectors; agricultural development strategies and their impact on output, income distribution and poverty alleviation; integration of economic agricultural and nutritional planning. The approach followed is quantitative and empirical.

664 Microeconomic Issues in Agricultural Development Spring. 3 credits. Prerequisite: Agricultural Economics 608, Economics 311, or permission of instructor.
T R 11:15–12:30. R. Barker.
Issues such as production efficiency, induced technological change, allocation of research resources, and the distribution of benefits from new technology are discussed. The theoretical argument is related to applied research problems.

665 Seminar on Latin American Agricultural Policy Fall. 3 credits. Prerequisite: Agricultural Economics 464 or work in Latin American economic and social development.
T 2:30–4:25. D. K. Freebairn.
An examination of policies for the development of the agricultural sector in Latin America, including an identification of policy objectives and a review of the instruments of public-policy implementation. Particular attention is paid to the interactions of agrarian structure, agricultural productivity, and rural welfare.

666 Seminar in Agricultural Development Fall or spring. 3 credits. The seminar is normally taught when a visiting professor is available who has had recent direct experience in low-income countries.
Hours to be arranged.
An analysis of current problems for the development of the agricultural sector of low-income countries, with emphasis on the implications of such problems to the definition of research.

699 M.P.S. Research 1–6 credits. Prerequisite: registration as an M.P.S. student. Credit is granted for the M.P.S. project report.

700 Topics in Agricultural Economics Fall or spring. Limited to graduate students. Credit, class hours, and other details arranged with a faculty member.
This course is used to offer special topics in agricultural economics that are not covered in regular class offerings. More than one topic may be given each semester in different sections. The student must register in the section appropriate to the topic being covered; the section number is provided by the instructor.

708 Advanced Production Economics Fall. 3 credits. Prerequisites: Agricultural Economics 608, 710, or equivalents.
Hours to be arranged. R. N. Boisvert.
Theoretical and mathematical developments in production economics, with emphasis on estimating microproduction and macroproduction relationships, scale economies, technical change, factor substitution, and recently developed functional forms. Discussions of several other selected topics such as risk, supply response, and household production functions change from year to year based on student interest.

710 Econometrics I Spring. 4 credits. Not open to undergraduates. Prerequisites: Statistics 416 and 601 or equivalent.
Lecs, T R 2:30–4:25. W. G. Tomek.
This course covers basic topics in econometrics starting with least squares estimation of the linear regression model and continuing with other standard topics. About four weeks are devoted to simultaneous-equations methods. The course is taught at an intermediate level, using matrix algebra, with emphasis on empirical research and is intended mainly for Ph.D. students who plan to become professional economists.

711 Econometrics II Fall. 4 credits. Prerequisite: Agricultural Economics 710 or equivalent. Statistics 417 recommended.
Lecs, T R 10:10–12:05; 1½-hour computing labs to be arranged. T. D. Mount.
Coverage beyond that of Agricultural Economics 710 of generalized least squares, models with stochastic regressors, testing linear hypotheses, and the effects of specification errors. Applications include seemingly unrelated regressions, three-stage least squares, estimation with pooled data, models with stochastic coefficients, and distributed lag models. Other topics covered are principal components, factor analysis, and probit and logit analysis, with extensions to deal with multinomial problems.

712 Quantitative Methods I Fall. 4 credits. Prerequisite: Statistics 416 or equivalent. Statistics 417 suggested.
Lecs, M W F 11:15. R. N. Boisvert.
A comprehensive treatment of linear programming and its extensions, including postoptimality analysis, goal programming, and the transportation model. Special topics in nonlinear programming, including separable, spatial equilibrium and risk programming models. Input-output models are treated in detail. Applications are made to agricultural, resource, and regional economic problems.

713 Quantitative Methods II Spring. 4 credits. Prerequisite: Agricultural Economics 712 or permission of instructor.
Lecs, M W F 9:05–9:55; disc, F 12:20–2:15.
R. A. Milligan.
A study of quantitative techniques used to solve dynamic problems. The first half of the course is concerned with dynamic optimization; the second, with simulation.

717 Research Methods in Agricultural Economics Spring. 2 credits. Limited to graduate students.
M 1:25–3:20. B. F. Stanton, D. G. Sisler.
Discussion of the research process and scientific method as applied in agricultural economics. Topics

include problem identification, hypotheses, sources of data, sampling concepts and designs, methods of collecting data, questionnaire design and testing, field organization and analysis of data. During the semester each student develops a research proposal which may be associated with his or her thesis.

730 Seminar on Agricultural Trade Policy Spring. 3 credits. Limited to graduate students. Prerequisites: Agricultural Economics 430 and basic familiarity with quantitative methods. Offered alternate years.
F 1:25–4. D. G. Sisler.
A discussion of selected topics in agricultural trade policy, such as export promotion versus import substitution in developing countries, and the role of international commodity agreements. The preparation of a term paper is an important part of the course.

[731 Seminar on Methods of Trade and Commodity Policy Analysis Spring. 3 credits. Limited to graduate students. Prerequisites: basic training in quantitative methods (Agricultural Economics 710 and 712 or equivalent) and permission of instructor. Offered alternate years. Not offered 1982–83.
F 1:25–4. Staff.
A discussion of the structure, use, and usefulness of alternative quantitative methods of commodity policy analysis. Preparing a term paper is an important part of the course.]

742 Agricultural Markets and Public Policy Spring. 3 credits. Limited to graduate students. Prerequisite: familiarity with multiple regression techniques on the level of Statistics and Biometry 601.
T R 12:20–2:15. W. H. Lesser.
Develops the concepts and methodology for applying and analyzing the effects of public-policy directives on the improvement of performance in the United States food marketing system. Topics include a survey of industrial organization principles, antitrust and other legal controls, coordination systems in agriculture, and cooperative theory and performance. An application of these techniques to analyzing marketing problems in developing economies is also presented.

743 Export Marketing Fall. 3 credits. Prerequisite: permission of instructor. Estimated cost of field trip, $85.
Lec, R 2:30–4:25. Overnight field trip to New York City required. M. E. Brunk.
The history and development of commercial United States exports of agricultural commodities and the mechanics and procedures of exporting. Alternatives in sales contracts, shipping, insurance, financing, business structure, researching markets, and promotion. Trading experiences of specific commodity specialists.

750 Economics of Renewable Resources Spring. 4 credits. Prerequisites: Economics 509 and Economics 518, or Agricultural Economics 713.
T R 2:30–4:25. J. M. Conrad.
This course focuses on recent developments in mathematical bioeconomics as they relate to the management of renewable resources. The theory and methods of dynamic optimization are briefly reviewed. Theory and applied studies in fishery, forestry, and water resource economics are examined, along with the role and effectiveness of alternative public policies.

[751 Seminar on Agricultural Policy Spring. 2 credits. Limited to graduate students. Offered alternate years. Not offered 1982–83.
W 1:25–3:20. K. L. Robinson.
A review of the professional literature relating to agricultural policy issues, and techniques appropriate to the analysis of such issues.]

754 Sociotechnical Aspects of Irrigation (also Rural Sociology 754) Spring. 3 credits.
Hours to be arranged. R. Barker, M. L. Barnett, E. W. Coward, Jr., G. Levine.

Agricultural Engineering

N. R. Scott, chairman; L. D. Albright, J. A. Bartsch, J. K. Campbell, J. R. Cooke, R. B. Furry, R. W. Guest, W. W. Gunkel, D. A. Haith, W. W. Irish, L. H. Irwin, W. J. Jewell, R. K. Koelsch, G. Levine, R. C. Loehr, H. A. Longhouse, D. C. Ludington, W. F. Millier, R. A. Parsons, R. E. Pitt, G. E. Rehkugler, J. W. Spencer, T. S. Steenhuis, L. P. Walker, M. F. Walter

110 Farm Metal Work Fall or spring. 2 credits.
Lec, R 9:05; fall labs, M or T 1:25–4:25; spring labs, M T or R 1:25–4:25. Staff.
M lab, limited to 24 students, includes instruction in the fundamentals of metal lathe work and arc and oxyacetylene welding. T and R labs, each limited to 20 students, include instruction in sheet metal work, pipe fitting, hot and cold metal work, and arc and acetylene welding.

131 Elements of House Design Spring. 3 credits. See D&EA 120, Residential Technology.

132 Farm Carpentry Fall. 2 credits. Each lab limited to 15 students.
Lec, T 9:05; labs, W or R 1:25–4:25. Staff.
Instruction in the fundamentals of farm carpentry, including concrete work, and equipment and buildings constructed of wood. Each student is required to plan and construct an approved carpentry project.

151 Introduction to Agricultural Engineering and Computing Fall. 2 credits. Prerequisite: one term of calculus or concurrent registration in a calculus course.
Lec, T 1:25; lab, F 1:25–3:20. G. E. Rehkugler.
An introduction to digital computing using the PL/C language through the use of computing problems in agricultural engineering subjects and related areas such as environmental technology and agriculture.

152 Computing with Graphics Spring. 2 credits. Prerequisite: Agricultural Engineering 151.
Lec, T 1:25; lab, F 1:25–3:20. R. B. Furry.
An introduction to digital computing using the FORTRAN language. Applications to engineering graphics.

153 Engineering Drawing Fall. 2 credits. Limited to 72 students (36 in each lab).
Lecs, M 9:05; lab, M or T 1:25–4:25.
H. A. Longhouse.
Designed to promote an understanding of the engineer's universal graphic language. The lectures and laboratories develop working knowledge of drawing conventions, drafting techniques, and their application to machine and pictorial drawing problems. Introduction to descriptive geometry and use of interactive computer graphics is included.

200 Undergraduate Seminar Spring. 1 credit.
Lec, M 2:30. N. R. Scott.
A forum to discuss the contemporary and future role of agricultural engineering in society. A series of lectures will be given by practicing agricultural engineers, Cornell faculty members, and students. Written critiques are required. Students may take the seminar more than once but are limited to 2 credits maximum.

201 Introduction to Energy Technology Spring. 3 credits. Prerequisite: high school or college physics. S-U grades optional.
Lec, M W F 10:10. L. D. Albright.
Basic concepts of energy and traditional and alternate sources of energy. The energy transfer process is investigated. Topics include heating, cooling, solar radiation, electricity, hydropower, refrigeration, wind power, geothermal energy, biogas production, and energy economics.

208 Application of Physical Sciences I Fall. 3 credits. Prerequisite: a term of calculus and high school physics or a year of college physics.
Lec, T R 8:20–9:55; rec, W 8 or 9:05.
D. C. Ludington.
The application of statics, dynamics, mechanics of materials, and fluid mechanics to physical problems in agriculture. Topics include torque, free-body diagrams, friction, energy, stress, bending, shear, fluid flow, and wall pressures. Emphasis is on problem solving.

209 Application of Physical Sciences II Spring. 3 credits. Prerequisite: Agricultural Engineering 208.
Lecs, T R 8:20–9:55; rec, W 8 or 9:05.
D. C. Ludington.
A continuation of Agricultural Engineering 208. The laws of thermodynamics and principles of energy transfer, psychrometrics, and electricity are covered. Topics include applications in agriculture of the various gas and vapor cycles used in engines and refrigeration, heat conduction through multiple layers, convection, thermal radiation, and behavior of air and water vapor mixtures. Solving practical problems is emphasized.

211 Agricultural Mechanization: An International Perspective Fall. 2 credits. S-U grades optional.
T R 9:05–9:55. J. K. Campbell.
A study of the tools and machines that are used to mechanize agriculture, with emphasis on developing countries. Topics include animal and mechanical power; tillage, planting, and harvesting tools and machines; and policy considerations.

221 Plane Surveying Fall. 3 credits. Limited to 90 students (30 per lab). S-U grades optional.
Lecs, T R 11:15; lab, M T or W 1:25–4:25. Staff.
An introduction to plane surveying. The use and care of equipment is stressed during field problems related to construction and mapping.

250 Engineering Applications in Biological Systems Spring. 3 credits. Prerequisite: coregistration in Mathematics 294; thermodynamics suggested or permission of instructor. Recommended for the sophomore year.
Lec, M W F 12:20. R. E. Pitt.
Case studies of engineering problems in agricultural and biological systems, including animal and crop production, environmental control, energy, and food engineering. Emphasis is on the application of mathematics, physics, the engineering sciences, and biology to energy and mass balances in agricultural systems.

304 Introduction to Computer Uses in Data Analysis Spring. 4 credits. Each lab limited to 36 students. Prerequisite: one course in college mathematics or statistics or permission of instructor. S-U grades optional.
Lecs, T R 11:15; lab, M T W R or F 1:25–2:15.
Prelims: 7:30 p.m. Feb. 24 and April 7. R. B. Furry.
An introductory course in computing for those interested in using digital computers to handle data. Topics include description and preparation of data, preparing and processing computer programs, computer attributes and applications, computer library programs, and related computing facilities. No prior knowledge of computers or computer languages is necessary.

305 Principles of Navigation Fall. 4 credits.
Lecs, M W F 8; disc, R 8. D. C. Ludington.
Coordinated systems, chart projections, navigational aids, instruments, compass observations, tides and currents, soundings. Celestial navigation: time, spherical trigonometry, motion of stars and sun, star identification, position fixing, Nautical Almanac. Electronic navigation.

310 Advanced Farm Metal Work Spring. 1 credit (2-credit option in spring). Prerequisite: Agricultural Engineering 110 or permission of instructor.

Lab W 1:25–4, (second lab must be arranged for 2-credit option). Staff.
Advanced welding and metal construction project.

311 Farm Machinery Fall. 3 credits. Each lab limited to 16 students. Prerequisite: high school physics or equivalent.
Lec, T R 10:10; rec-lab, T W or R 1:25–4:25.
W. F. Millier.
A study of the operating principles, use, selection, and methods of estimating costs of owning and operating farm machines. Lab work includes practice in the calibration of planting, fertilizing, and pesticide application machinery, and study of the functional characteristics of agricultural machines and machine components.

312 Internal Combustion Engines for Agriculture Spring. 3 credits. Each lab limited to 16 students. Students missing the first week of classes without permission of instructor are dropped so others may register. Prerequisite: high school physics or equivalent.
Lec, T R 11:15; lab, T W or R 1:25–4:25.
W. F. Millier.
A study of the principles of operation, adjustment, and maintenance of hydrocarbon-fueled single-cylinder and multicylinder internal combustion engines. Topics include engine cycles, fuels, lubricants, carburetion, fuel injection systems, ignition, charging circuits, valve reconditioning, and engine testing.

315 Electricity: Its Use and Control Spring. 3 credits. Prerequisite: Physics 102 or equivalent.
Lec, T R 10:10; lab, T or R 1:25–4:25.
D. C. Ludington.
The application and control of electricity for power, lighting, and heat are studied. Principles of operation and selection of single-phase equipment for agriculture are emphasized. Conventional and solid state controls are included. Laboratories offer hands-on experience.

321 Soil and Water Conservation Spring. 2 credits. Must be taken with Agronomy 321. S-U grades optional.
Lec, F 8; disc-lab, M 1:25–4:25. Staff.
A study of the principles and practices used in the solution of soil and water conservation problems. Both farm and nonfarm problems are explored. Engineering aspects of erosion control, water management, water storage, and drainage are examined.

331 Farmstead Production Systems Fall. 3 credits. S-U grades optional.
M W F 8. Staff.
A study of layout, material handling, and environment associated with agricultural production on the farmstead. Planning and design techniques pertaining to biointrinsic and integrated systems are emphasized.

332 Farm Buildings Design Fall. 2 credits. Prerequisite: concurrent or previous registration in Agricultural Engineering 331. Intended for students without backgrounds in statics or properties of structural materials.
Lec-lab, R 1:25–4:25. Staff.
Structural design of buildings used for farmstead production systems. Wood is emphasized as a structural material.

371 Water and Chemical Movement in the Landscape Spring. 3 credits. Prerequisites: Agronomy 200 or equivalent or permission of instructor.
Lec, T R 9:05; lab-lec, W 1:25–4:25.
T. S. Steenhuis, R. E. Muck.
The hydrologic cycle, major chemical cycles; and their interactions with the land will be the basis of this course. Within this framework, the movement of any chemical (nutrient, pesticide, heavy metal) through the environment along with its implications with regard to land disposal of wastes and agricultural production is discussed. Emphasizes basic understanding and the probabilistic nature of the processes involved, but some problem solving is done.

401 Career Development in Agricultural Engineering Fall. 1 credit. Limited to seniors. S-U grades only.
Lec, T 12:20. W. W. Gunkel.
A presentation and discussion of the opportunities and qualifications for, and responsibilities of positions of, service in the various fields of agricultural engineering.

[414 Power Transmission Systems Spring. 2 credits. Limited to 16 students. Prerequisite: Agricultural Engineering 312. Not offered 1982–83.
Lec, W 10:10; lab, F 10:10–1:10. W. F. Millier.
A study of the principles and operation of hydraulic and mechanical-power transmission systems used in agricultural tractors and equipment. Hydraulic-power transmission includes system components, circuit diagrams, hydrostatic transmissions, and system analysis. Mechanical-power transmission includes clutches, brakes, parallel shaft and planetary transmissions, traction, and drawbar horsepower.]

451 Energy Systems Engineering Spring. 3 credits. Prerequisite: Agricultural Engineering 250, Mathematics 294, and thermodynamics.
Lec, M W F 12:20. L. P. Walker.
This course is structured to provide engineering students with an understanding of the physical and biological principles of alternative energy technologies. Our terrestrial energy balance and its impact on energy availability will be discussed. Several technical alternatives for harvesting energy from our environment will be investigated. In addition, some of the logistical and technical problems associated with integrating alternative energy technologies into agricultural and industrial production systems will be explored.

461 Agricultural Machinery Design Fall. 3 credits. Prerequisite: mechanical design or equivalent.
Lec, T R 10:10; lab, F 1:25–4:25. W. W. Gunkel.
The principles of design and development of agricultural machines to meet functional requirements. Emphasis is given to computer-aided analysis and design, stress analysis, selection of construction materials, and testing procedures. Engineering creativity and agricultural machine systems are also stressed.

462 Agricultural Power Spring. 3 credits. Prerequisite: dynamics and thermodynamics or equivalent.
Lec, T R 10:10; lab, F 1:25–4:25. W. W. Gunkel.
Use of energy in agriculture. Emphasis is given to basic theory and analysis and testing of internal combustion engines and suitable components for use in farm tractors and other power applications. Soil mechanics related to traction and vehicle mobility; economics and human factors in design are considered.

465 Processing and Handling Systems for Agricultural Materials Fall. 3 credits. Prerequisite: Agricultural Engineering 250.
Lec, T R 11:15; lab, W 2–4:25. R. B. Furry.
Drying, fluid, flow measurement, and material handling applications, with an introduction to dimensional analysis and controls for agricultural engineering applications.

466 Engineering Design and Analysis of Food Processing Equipment Fall. 3 credits. Prerequisite: Food Science 302, its equivalent, or concurrent enrollment in an engineering curriculum.
T R 9:05, R 1:25–4:25. G. E. Rehkugler.
The analysis and design of food-processing equipment from the point of view of selecting and designing equipment appropriate for transporting or modifying a food product.

471 Soil and Water Engineering Fall. 3 credits. Prerequisite: fluids, calculus.
Lec, T R 9:05; lab, R 2:30–4:25. M. F. Walter.
The application of engineering principles to problems of soil and water management. Analysis and design of water management systems including hydrology, hydraulic structures, wells, channels, small reservoirs, erosion and sediment control.

475 Introduction to Environmental Systems Analysis Fall. 3 credits. Prerequisite: computer programming and one year of calculus.
M W F 11:15. D. A. Haith.
Introduction to systems analysis and its application to environmental quality management. Simulation, linear programming, and dynamic programming applied to problems in water and air pollution control, solid waste disposal, agricultural wastes, and so forth.

481 Agricultural Structures Design Spring. 3 credits. Prerequisite: Structural Engineering CEE G301.
Lec, T R 1:25; disc-lab, R 2:30–4:40. Staff.
Application of basic structural concepts to design of agricultural structures. Emphasizes wood structures, including design of trusses, rigid frames, prefabricated panels, and columns.

482 Environmental Control for Animals and Plants Spring. 3 credits. Prerequisite: Agricultural Engineering 250 and thermodynamics.
Lec, M W 11:15; lab, M 1:25–4:25. L. D. Albright.
Thermal interchanges between animals (including humans) and plants and the environment. Physiological principles affecting thermal comfort and health. Ventilation, thermal modeling, psychrometrics, solar energy, and weather phenomena.

491 Highway Engineering Fall. 3 credits. Prerequisite: Soil Mechanics CEE D301 or permission of instructor. Offered alternate years.
Lec, W F 12:20; lab, M 12:20–3:20. L. H. Irwin.
Highway systems, planning, economy analysis, road location and geometric design, traffic engineering, drainage design, and soil engineering. Introduction to highway materials, pavement design, and highway maintenance.

[492 Bituminous Materials and Pavement Design Spring. 3 credits. Prerequisite: concurrent registration in Soil Mechanics CEE D301 or permission of instructor. Offered alternate years. Not offered 1982–83.
Lec, W F 12:20; lab, M 12:20–3:20. L. H. Irwin.
Properties of asphalts, aggregates, and bituminous mixtures; bituminous mixture design. Seal coat and surface treatment design. Soil stabilization methods. Flexible pavement design methods, rigid pavement design methods, pavement design for frost conditions.]

497 Special Problems in Agricultural Engineering Fall or spring. Variable 1–3 credits. S-U option. Normally reserved for seniors in upper two-fifths of their class. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade. Prerequisite: adequate ability and training for the work proposed.
Staff.
Special work in any area of agricultural engineering on problems under investigation by the department or of special interest to the student, provided, in the latter case, that adequate facilities can be obtained.

501–502 M.P.S. Project Fall and spring. 1–6 credits. Required of each M.P.S. candidate in the field.
Hours to be arranged. Staff.
A comprehensive project emphasizing the application of agricultural technology to the solution of a real problem.

551–552 Agricultural Engineering Design Project Fall and spring. 6 credits. Prerequisite: admission to the M.Eng.(Agr.) degree program or equivalent preparation.
Hours to be arranged. L. D. Albright and staff.
Comprehensive design projects dealing with existing engineering problems in the field. Emphasis is on the formulation of alternative design proposals that include consideration of economics, nontechnical factors, engineering analysis, and complete design for the best design solution.

652 Instrumentation Spring. 3 credits. Prerequisite: electrical systems or permission of instructor.
Lecs, T R 12:20; lab to be arranged. N. R. Scott.
The application of instrumentation concepts and systems to physical and biological measurements. Characteristics of instruments, signal conditioning and interfacing, shielding and grounding, transducers, data acquisition systems, microprocessors, microcomputers, and radiotelemetry are considered.

[672 Drainage Engineering Spring. 4 credits. Prerequisite: Agricultural Engineering 471 or permission of instructor. Offered alternate years. Not offered 1982–83.
Lecs, M W F 10:10; lab, R 1:25–4:25.
T. S. Steenhuis.
Analysis and design of surface, subsurface, and combined drainage systems, with emphasis on agricultural applications. The elements of surface, channel, and porous media flow are analyzed, as well as entire systems of collectors, storages, pumps, and methods of overflow protection for large areas. Effect of drainage on water quality is reviewed.]

673 Irrigation Engineering Spring. 3 or 4 credits. Prerequisites: Agronomy 200 and Agricultural Engineering 471 or permission of instructor. Offered alternate years.
Lecs, M W F 10:10; lab, R 1:25–4:25.
T. S. Steenhuis.
Analysis and design of irrigation systems. Soil-plant-water relationships, water quality, water supplies, water delivery systems, and water distribution systems are analyzed.

677 Treatment and Disposal of Agricultural Wastes Fall. 3 credits. Prerequisite: permission of instructor.
3 lecs, hours to be arranged. R. C. Loehr.
Emphasis is on the causes of agricultural waste problems and the application of fundamentals of treatment and control methods to minimize related pollution. Fundamentals of biological, physical, and chemical pollution control methods are applied to animal, food production, and food-and-fiber-processing wastes, using actual systems as examples.

678 Nonpoint Source Water Quality Models Spring. 1–3 credits. Limited to upperclass or graduate students. Prerequisites: computer programming, a year of calculus, and permission of instructor. S-U grades optional.
Lecs, M W F 9:05. D. A. Haith.
Mathematical models for analysis of agricultural and urban nonpoint sources. Three 1-credit sequential units: (1) stormwater models—computer models of runoff and moisture balances; (2) basic nonpoint source models—simple models for urban and agricultural runoff, land application of wastes; (3) agricultural simulation models—pesticides, nutrients, and salinity.

679 Use of Land for Waste Treatment and Disposal Spring. 3 credits. Prerequisite: permission of instructor.
Lecs, T R 3:35–4:50. W. J. Jewell.
Covers the social, legal, and technical factors, the properties of land and crop systems that make land application of wastes a viable alternative, and the use of fundamentals in the development of regulations and the design of full-scale units.

685 Biological Engineering Analysis Fall. 4 credits. Prerequisite: Engineering T&AM 310 or permission of instructor.
M W F 12:20. R. E. Pitt.
Engineering problem-solving strategies and techniques are explored. Students solve several representative engineering problems that inherently involve biological properties. Emphasis is on formulation and solution of mathematical models and the interpretation of results. The student's knowledge of fundamental principles is used extensively.

700 General Seminar Fall. Noncredit.
M 12:20. N. R. Scott.
Presentation and discussion of research and special developments in agricultural engineering and related fields.

701 Special Topics in Agricultural Engineering Fall or spring. 1–6 credits. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. Staff.
Topics are arranged by the staff at the beginning of the term.

750 Orientation for Research Fall. 1 credit. Limited to newly joining graduate students. S-U grades only.
Lecs, first 5 weeks, M 3:20; remainder to be arranged. G. E. Rehkugler.
An introduction to departmental research policy, programs, methodology, resources, and degree candidates' responsibilities and opportunities.

761 Power and Machinery Seminar Spring. 1 credit. Limited to graduate students. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. W. W. Gunkel.
Study and discussions of research and new developments in agricultural power and machinery.

771 Soil and Water Engineering Seminar Fall or spring. 1–3 credits. Prerequisite: graduate status or permission of instructor. S-U grades optional.
Hours to be arranged. Staff.
Study and discussion of research or design procedures related to selected topics in irrigation, drainage, erosion control, hydrology, and water quality.

775 Agricultural Waste Management Seminar Spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. Staff.
Management of agricultural wastes, with emphasis on physical, chemical, biological, and economic factors affecting waste production, treatment and handling, utilization, and disposal.

781 Agricultural Structures and Related Topics Seminar Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only.
Disc to be arranged. L. D. Albright.
Consideration of farmstead production systems, with emphasis on biological, economic, environmental, and structural requirements.

785 Biological Engineering Seminar Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only.
Disc to be arranged. N. R. Scott, J. R. Cooke.
The interactions of engineering and biology, especially the environmental aspects of plant, animal, and human physiology, are examined in order to improve communication between engineers and biologists.

Agronomy

R. F. Lucey, chairman; M. Alexander, W. H. Allaway, A. A. App, D. R. Bouldin, R. B. Bryant, B. E. Dethier, W. B. Duke, J. M. Duxbury, G. W. Fick, D. L. Grunes, W. K. Kennedy, W. R. Knapp, W. W. Knapp, J. Kubota, T. A. LaRue, D. J. Lathwell, A. C. Leopold, D. L. Linscott, M. B. McBride, R. D. Miller, R. L. Obendorf, G. W. Olson, A. B. Pack, D. A. Paine, J. H. Peverly, W. S. Reid, S. J. Riha, T. W. Scott, R. R. Seaney, T. L. Setter, P. L. Steponkus, F. N. Swader, A. Van Wambeke, R. M. Welch, M. J. Wright, R. W. Zobel

Biometeorology

101 Basic Principles of Meteorology Fall. 3 credits. Limited to 140 students.
Lecs, T R 11:15; lab, M T W or R 1:25–4:25.
B. E. Dethier.
A simplified treatment of the structure of the atmosphere: heat balance of the earth; general and secondary circulations; air masses, fronts, and cyclones; hurricanes, thunderstorms, tornadoes, and atmospheric condensation. In the laboratory, emphasis is on techniques of analysis of weather systems.

103 Basic Principles of Meteorology, Laboratory Fall. 1 credit. Prerequisite: an introductory course in meteorology without a lab.
M T W R 1:25–4:25. B. E. Dethier.
Techniques of analysis of weather systems and the application of dynamical and empirical methods of predicting the daily atmospheric circulation.

314 Agricultural Meteorology Fall or spring. 3 credits. Limited to 35 students.
T R 10–11:25. A. B. Pack.
An introduction to the relationships of radiant energy, temperature, wind, and moisture in the atmosphere near the ground. The interplay between physical processes of the atmosphere, plant canopies, and soil is examined. Moisture relationships in the atmosphere-soil-plant continuum, the effects of environmental modification, and the bioclimatic requirements of plants are also discussed.

325–326–327–328 Meteorological Communications 325 and 327, fall; 326 and 328, spring. 1 credit each semester. Primarily for undergraduate meteorology majors. S-U grades optional.
Hours to be arranged. Staff.
The student becomes acquainted with facsimile, teletype, and satellite receiving equipment and the data products used in weather forecasting.

411–412 Theoretical Meteorology I and II Fall and spring. 3 credits each semester. Prerequisites: a year each of calculus and physics.
M W F 10:10. W. W. Knapp.
Fall semester topics include meteorological coordinate systems, variation of wind and pressure fields in the vertical, winds in the planetary boundary layer, surfaces of discontinuity, mechanisms of pressure change, vorticity and circulation. Topics considered in the spring term include thermodynamics of dry air, water vapor and moist air, hydrostatics and stability.

417 Physical Meteorology Fall. 3 credits. Prerequisite: a year each of calculus and physics. Offered alternate years.
M W F 12:20. W. W. Knapp.
Primarily a survey of natural phenomena of the atmosphere, with emphasis on their underlying physical principles. Topics include composition and structure of the atmosphere, atmospheric optics, acoustics and electricity, solar and terrestrial radiation, and principles of radar probing of the atmosphere.

430 Synoptic Meteorology I Fall. 4 credits. Prerequisites: either Atmospheric Sciences 411 and 412 or permission of instructor.
Lecs, W R 9:05; lab, F 2:30–4:25. D. A. Paine.
The application of quasi-geostrophic theory as a diagnostic and forecast method, including the use of minicomputer products derived from the barotropic, baroclinic, and primitive equation numerical models.

Lab work includes surface and upper air analyses and thickness and vorticity computations using radiosonde data documenting macroscale cyclogenesis.

432 Synoptic Meteorology II Spring. 4 credits. Prerequisite: Atmospheric Sciences 430 or permission of instructor.
Lecs, W F 1:25; lab, R 2:30–4:25. D. A. Paine.
The conservation laws for mass, energy, and momentum in constant entropy coordinates. Derivation and construction of adiabatic versus diabatic trajectories. Ertel's potential vorticity theorem evaluated by the quasi-Lagrangian trajectory technique. The laboratory employs the Atmospheric Sciences 430 storm data to contrast constant pressure and isentropic methods of analysis.

[464 Biometeorology Spring. 2 credits. Prerequisite: permission of the instructor (no course prerequisites). Not offered 1982–83.
Lec, W 1:25; lab, W 2:30–4:25. D. A. Paine.
Interactivity between the atmosphere and biosphere is of central concern when considering many of the challenges of this decade, such as acid rain, severe winter cold stress, fossil fuel burning, and CO_2 increase. Empirical and theoretical models of such interactivity is presented. A systems-level approach to environmental protection decisions is emphasized.]

499 Undergraduate Research in Meteorology Fall and spring. 1–3 credits.
Staff.
Required of honors students in the physical sciences majoring in meteorology.

650 Special Topics in Meteorology and Climatology Fall or spring. 1 or more credits.
Staff.
A study of meteorological topics more advanced than, or different from, those in other courses. Subjects depend on the background and desires of those enrolled.

691 Seminar in Meteorology Fall or spring. Prerequisite: permission of instructor.
Hours to be announced. B. E. Dethier.
Subjects such as weather modification, paleoclimatology, and atmospheric pollution.

962 Research in Meteorology Fall or spring. 1 or more credits.
Staff.
Thesis research.

Crop Science

311 Grain Crops Fall. 4 credits. Prerequisite: Agronomy 200 or Biological Sciences 241.
Lecs, M W F 10:10; lab, T or W 1:25–4:25. One or two field trips during lab periods (until 5 p.m. or on weekends). R. L. Obendorf.
Principles of field-crop growth, development and maturation, species recognition, soil and climatic adaptations, liming and mineral nutrition, weed control, cropping sequences, management systems, and crop improvement are considered. Grain, protein, fiber, and sugar crops are emphasized.

312 Forage Crops Spring. 4 credits. Prerequisites: Agronomy 200 or Biological Sciences 241. Recommended: Animal Science 112.
Lecs, M W F 11:15; lab, M T or W 1:24–4:25. One field trip during a lab period (until 5 p.m.) or on a weekend. G. W. Fick.
The production and management of crops used for livestock feed are considered in terms of establishment, growth, maintenance, harvesting, and preservation. Forage grasses, forage legumes, and corn are emphasized, and consideration is given to their value as livestock feed in terms of energy, protein, and other nutritional components.

314 Production of Tropical Crops Spring. 3 credits. Prerequisite: a course in crop production.
Lecs, M W F 10:10. M. J. Wright.
An introduction to the characteristics and culture of the principal food staple crops of the tropics and subtropics and of some of the crops grown for export. Vegetables and fruits are not emphasized.

315 Weed Science Fall. 3 credits. Prerequisites: Agronomy 200, and Biological Sciences 103 and 104 or Biological Sciences 241.
Lecs, T R 8; lab, M T or W 2–4:25. W. B. Duke.
Principles of weed science are examined. Emphasis is given to (a) weed ecology, (b) chemistry of herbicides in relation to effects on plant growth, and (c) control of weeds in all crops. Laboratory covers weed identification, herbicide selectivity, herbicide injury symptoms, and farm herbicide problem solving.

[317 Seed Science and Technology Fall. 3 credits. Prerequisite: Biological Sciences 241 or equivalent. Offered alternate years. Not offered 1982–83.
Lecs, T R 11:15; lab, R 1:25–4:25; two all-day Saturday field trips will be scheduled during the semester. A. G. Taylor, Geneva Experiment Station. (Ithaca contact, R. L. Obendorf.)
The principles and practices involved in the production, harvesting, processing, storage, testing, quality management, certification, and use of high-quality seed from improved cultivars. Information is applicable to various kinds of agricultural seeds.]

371 Undergraduate Research in Crop Science Fall or spring. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to course enrollment material.
Hours to be arranged. Staff.
Independent research on current problems selected from any phase of crop science.

[610 Physiology of Environmental Stresses Spring. Prerequisite: Biological Sciences 242 or 341. 3 credits. Offered alternate years. Not offered 1982–83.
Lecs, T R 10:10. P. L. Steponkus.
A study of the responses of plants to environmental stresses including chilling, freezing, high temperature, and drought. Emphasis is on the physiological and biochemical basis of injury and plant resistance mechanisms at the whole-plant, cellular, and molecular levels.]

[611 Crop Simulation Modeling Fall. 3 credits. Prerequisite: Biological Sciences 242 or 341. Recommended: computer programming experience. Offered alternate years. Not offered 1982–83.
M W F 11:15. G. W. Fick.
A study of existing crop models is followed by development and refinement of programs representing the students' work. The computer language CSMP is used. Emphasis is on quantitative formulation and testing of complex hypotheses related to crop growth. Carbon exchange, transpiration, microclimate, soil water supply, root functions, and dry-matter distribution in growing crops are covered.]

[612 Grain Formation Spring. 3 credits. Prerequisite: plant physiology. Not offered 1982–83.
M W F 12:20. R. L. Obendorf.
Morphology, physiology, and biochemistry of cereal, legume, and oil-seed formation, composition, storage, and germination. Emphasis is on the deposition of seed reserves during seed formation, stabilization of reserves during storage, and mobilization of reserves during germination. Coverage ranges from practical, "on-farm" problems to molecular biology.]

613 Ecology and Physiology Yield Fall. 3 credits. Prerequisite: plant physiology.
M W F 8. T. L. Setter.
A study of the constraints on crop productivity from a physiological perspective. Influence of environment and genetics on the assimilation, translocation, and partitioning of carbon and nitrogen during crop ontogeny. Emphasis on growth processes of vegetative plant organs.

651 Special Topics in Crop Science Fall or spring. 1–6 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Hours to be arranged. Staff.
The topic is arranged at the beginning of the term for individual study or for group discussions.

761 Graduate Research in Crop Science Fall, spring, or summer. Credit by arrangement. Limited to members of the graduate field.
Hours to be arranged.

790 Agronomy Seminar Noncredit.
See course description in soil science section below.

Related Courses in Other Departments

Forages of the Tropics for Livestock Production (Animal Sciences 403)

Special Studies of Problems of Agriculture in the Tropics (International Agriculture 602)

Protozoan Parasite Structure and Function (Veterinary Medicine 765)

Soil Science

200 Nature and Properties of Soils Fall or spring. 4 credits. Prerequisite: Chemistry 103, 207, or 215. S-U grades optional.
Lecs, M W F 9:05; lab, M T W or R 1:25–4:25. Fall, D. J. Lathwell; spring, T. W. Scott.
A comprehensive introduction to the field of soil science, with emphasis on scientific principles and their application in solutions of practical soil management problems.

301 Genesis, Classification, and Geography of Soils Fall. 4 credits. Prerequisite: Agronomy 200 or consent of instructor. S-U grades optional.
Lec, M W F 10:10; lab, W 1:25–4:25; all-day field trip required. R. B. Bryant.
The soil as a natural body. Factors and processes of soil formation. Principles of field identification, classification, survey, and interpretation. Geography of major kinds of soil of North America and the world in relation to environment and cultural patterns. Laboratory exercises and field trips assist in identifying and interpreting soils in relation to landscape.

302 Soil Morphology Fall. 1 credit. Prerequisite: Agronomy 200 or consent of instructor.
R 1:25–4:25; all-day field trip required. R. B. Bryant.
The principles for field identification of soil properties, profiles, and landscapes are presented. A series of soil pits are examined, described, classified, and interpreted in the field.

306 Soil Chemistry Spring. 3 credits. Prerequisite: Agronomy 200, Chemistry 103–104, or Chemistry 207–208.
M W F 9:05. M. B. McBride.
An introduction to the chemical nature and reactions of the mineral and organic components that comprise soils.

308 Soil Chemistry Laboratory Spring. 2 credits. Prerequisite: Agronomy 200, Chemistry 103–104, or Chemistry 207–208.
R 1:25–4:25. M. B. McBride.

Laboratory exercises are designed to measure soil-chemical properties using wet chemical and spectrophotometric methods. A weekly discussion period will follow each laboratory.

321 Soil and Water Conservation Spring. 2 credits. Prerequisites: Agronomy 200 and concurrent registration in Agricultural Engineering 321. S-U grades optional.
M W 8. W. H. Allaway.
A study of the principles and practices used in soil and water conservation, agronomic aspects of erosion control, water management, storage, drainage, and irrigation.

324 Soil Fertility Management Fall. 3 credits. Prerequisite: Agronomy 200 or permission of instructor.
M W F 9:05. D. R. Bouldin.
An integrated discussion of soil-crop yield relationships, with emphasis on the soil as a source of mineral nutrients for crops and the role of fertilizers and manure in crop production.

331 Aquatic Plant Management Fall. 3 credits. Prerequisites: Biological Sciences 101–102 and Chemistry 103–104 or equivalents.
T R 11:15; T 1:25–4:25. J. H. Peverly.
The chemistry and physiology of higher aquatic plants are studied from the inorganic solid, solution, and gaseous phases of the environment to cellular and subcellular levels of plants. Application of the basic physical and chemical concepts presented to predict effects on aquatic plant growth are illustrated in lab and field situations.

401 Geography and Appraisal of Soils of the Tropics Spring. 3 credits. Prerequisite: Agronomy 200 or equivalent. S-U grades optional.
Lecs, W F 12:20; disc, F 2:30–4:25. Staff.
The character of principal kinds of soils in the major regions of the tropics. Soil properties are related to the position in the landscape and to profile genesis. Emphasis is on soil properties as a basis for interpretation of crop management requirements and production potential. Lectures introduce principles whose applications are examined through discussions, problem solving, and independent reading.

403 Organic Soils Fall. 2 credits. Prerequisite: Agronomy 200. Offered alternate years.
W 1:25–4:25; some field trips will not return before 5:30. J. M. Duxbury.
A combination of field and laboratory study and discussion of the genesis, physical and chemical properties, agricultural uses, and management of organic soils.

404 Forest Soils Fall. 3 credits. Prerequisite: Agronomy 200 or permission of instructor.
Lecs, T R 8; lab, M or T 1:25–4:25; some field trips may not return before 5:30. S. J. Riha.
Ecology of forest soils. Application of basic physical and chemical principles to the study of energy, water, and nutrient budgets of forest ecosystems. Implications for forest management.

[406 Soil Microbiology, Lectures Spring. 3 credits. Prerequisite: Agronomy 200 or Microbiology 290. Offered alternate years. Not offered 1982–83.
M W F 10:10. M. Alexander.
A study of the major groups of soil microorganisms, their ecological interrelationships, and the biochemical functions of organisms in soil.]

466 Microbial Ecology Spring. 3 credits. Prerequisite: an elementary course in some facet of microbiology. Offered alternate years.
M W F 10:10. M. Alexander.
An introduction to the basic principles of microbial ecology. Attention is given to the behavior, activity, and interrelationships of bacteria, fungi, algae, and protozoa in natural ecosystems.

[480 Management Systems for Tropical Soils Spring. 3 credits. Prerequisite: Agronomy 401 or permission of instructor. S-U grades optional. Offered alternate years. Not offered 1982–83.
Lec, W F 8; disc, W 2:30–4:25. A. Van Wambeke.
Land evaluation in tropical areas; water requirements in semiarid tropics. Management of tropical soils in relation with nitrogen, acidity, liming, phosphorus, and other nutrients. Effects of cropping systems on soils, soil conservation methods, and erosion control.]

497 Special Topics in Soil Science Fall or spring. 1–6 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Hours to be arranged. Staff.
The topics are arranged at the beginning of the term for individual study or for group discussions.

499 Undergraduate Research in Soil Science Fall or spring. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to course enrollment material.
Hours to be arranged. Staff.
Independent research on current problems selected from any phase of soil science.

[506 Use of Soil Information and Maps as Resource Inventories Fall. 2 credits. S-U grades optional. For anyone interested in using soils. Offered alternate years. Not offered 1982–83.
T R 11:15. G. W. Olson.
Principles, practices, and research techniques in interpreting soil information and maps for planning, developing, and using areas of land.]

603 Pedology Spring. 3 credits. Prerequisite: Agronomy 301 or consent of instructor. Offered alternate years.
T R 10:30–12. R. B. Bryant.
Weathering, reactions, and processes of soil genesis. Principles of soil classification and the rationale and utilization of soil taxonomy. Development and significance of major groups of soils of the world.

606 Advanced Soil Microbiology Fall. 1 credit. Prerequisite: Agronomy 406 or permission of instructor. S-U grades only for graduate students.
T 12:20. M. Alexander.
Discussions of current topics in special areas of soil microbiology. Particular attention is given to biochemical problems in microbial ecology.

607 Soil Physics Fall. 3 credits. Prerequisites: Agronomy 200 and a year of college physics or permission of instructor. Offered alternate years.
M W F 11:15. R. D. Miller.
A study of physical properties and processes in soils, with emphasis on basic principles.

608 Water Status in Plants and Soils Fall. 2 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years.
Lec, 1 hour to be arranged; lab, R 1:25–4:25 or as arranged. R. D. Miller, T. L. Setter.
Techniques for field appraisal of the status of water in plants and soil, including methods used in evapotranspiration studies.

[609 Soil Organic Matter Fall. 2 credits. Prerequisites: Agronomy 200 and Chemistry 357–358 or equivalent. Offered alternate years. Not offered 1982–83.
T R 9:05. J. M. Duxbury.
A discussion of current concepts of the nature, mode of formation, dynamics, and role of organic matter in soils. Some consideration is given to the behavior of manufactured organic chemicals in the soil environment.]

701 Soil Chemistry and Mineralogy Fall. 3 credits. Prerequisites: Agronomy 200 and a year of physical chemistry, or permission of instructor. Offered alternate years.
T R 10:10–11:25. M. B. McBride.
Chemical properties of soils, with emphasis on structure and surface chemistry of soil minerals, ion exchange, mineral-solution equilibria, and adsorption reactions of soil clays and oxides.

[724 Soil Fertility Advanced Course Spring. 3 credits. Prerequisite: graduate status with a major or minor in agronomy. Offered alternate years. Not offered 1982–83.
T R 8:30–9:55. D. R. Bouldin.
A study of selected topics in soil-crop relationships, with emphasis on concepts of soil fertility, interpretation of experimental data, and soil fertilizer chemistry.]

760 Graduate Research in Soil Science Fall or spring. Credit by arrangement. Limited to students in the graduate field.
Hours by arrangement.

790 Agronomy Seminar Fall or spring. Noncredit. Required of graduate students majoring or minoring in the department.
T 4.

Related Course in Another Department

Special Studies of Problems of Agriculture in the Tropics (International Agricultural Development 602)

Animal Sciences

Department of Animal Science: R. J. Young, chairman; H. R. Ainslie, B. J. Apgar, D. E. Bauman, D. H. Beermann, R. D. Boyd, W. R. Butler, L. E. Chase, W. B. Currie, T. R. Dockerty, J. M. Elliot, R. W. Everett, H. N. Erb, R. H. Foote, D. G. Fox, J. A. Fitzgerald, D. M. Galton, R. C. Gorewit, W. Hansel, H. F. Hintz, D. E. Hogue, R. E. McDowell, W. G. Merrill, E. A. Oltenacu, P. A. Oltenacu, R. L. Quaas, J. B. Russell, S. W. Sabin, H. F. Schryver, R. D. Smith, C. J. Sniffen, J. R. Stouffer, M. L. Thonney, D. R. Van Campen, N. L. VanDemark, P. J. Van Soest, L. D. VanVleck, R. G. Warner

Department of Poultry and Avian Science: R. C. Baker, chairman; R. E. Austic, S. E. Bloom, G. F. Combs, Jr., D. L. Cunningham, R. R. Dietert, K. Keshavarz, H. G. Ketola, C. C. McCormick, J. A. Marsh, J. M. Regenstein, G. L. Rumsey, E. A. Schano, A. van Tienhoven

100 Introductory Animal Science Fall. 3 credits. For beginning students. S-U grades optional.
Lecs, W F 10:10; lab, T R or F 2–4:25. J. M. Elliot.
An introduction to animal science dealing with domestic animals and with current practices and problems of the livestock and meat industries. The place of the physical and biological sciences in animal agriculture is discussed. Emphasis is on the nutrition, physiology, breeding, and management of dairy cattle, beef cattle, sheep, swine, and horses.

105 Contemporary Perspectives of Animal Science Spring. 1 credit. Limited to freshmen, sophomores, and first-year transfers.
T 1:25, W 12:20. Staff.
A forum to discuss the contemporary and future role of animals in relation to human needs and career planning.

112 Livestock Nutrition Spring. 4 credits. Prerequisite: Chemistry 103 or 207. Recommended: Animal Science 100.
Lecs, M W F 10:10; lab, M T W R or F 2–4:25.
R. G. Warner.
An introduction to animal nutrition covering fundamentals of nutrition, the nutritive value of feeds, and the application of feeding standards to various forms of production in dairy and beef cattle, sheep, swine, and horses.

113 Nutrition of Companion Animals Fall, weeks 1–7. 1 credit. Prerequisite: Animal Science 112 or equivalent. S-U grades optional.
W 7:30–9:25 p.m. H. F. Hintz.
Nutrition of companion animals, with emphasis on the dog and cat. Digestive physiology, nutrient requirements, feeding practices, and interactions of nutrition and disease.

200 Animal Physiology Fall. 3 credits. Limited to sophomores and juniors except with permission of instructor. Prerequisite: a year of college biology. High-school level chemistry, physics, and math is assumed.
Lecs, M W F 9:05. W. B. Currie.
A general introduction to animal physiology with emphasis on developing physiologic concepts and an understanding of animal function in physiologic terms. Where suitable, examples are taken from ruminants or other domestic animals. Lectures and demonstrations are designed to encourage independent supportive study. This course provides a basis for more specialized physiology courses in animal science and supports the study of nutrition and the production courses. A major paper on a free-choice topic in physiology is required.

220 Animal Reproduction and Development Spring. 4 credits. Each lab limited to 36 students. Prerequisite: a year of college biology or equivalent.
Lecs, T R 9:05; demonstration and lab, M T W or R 2–4:25 or T 10:10–12:35 or F 12:20–2:45.
R. H. Foote.
An introduction to the comparative anatomy and physiology of reproduction of farm animals. The life cycle from fertilization through development and growth to sexual maturity is studied, with emphasis on physiological mechanisms involved, relevant genetic control, and application to fertility regulation of animal and human populations. An audiotutorial lab is available for independent study to prepare for laboratory experiments.

221 Introductory Animal Genetics Fall. 3 credits. Prerequisite: a year of college biology.
Lecs, T R 9:05; disc, T W R or F 2–4:25.
E. J. Pollak.
An examination of basic genetic principles and their application to the improvement of domestic animals, with emphasis on the effects of selection and mating systems on animal populations.

230 Poultry Biology Spring. 3 credits.
Lecs, T R 11:15; lab, W 2–4:25. Field trips during lab periods may last longer. R. E. Austic.
Designed to acquaint the student with the scope of the poultry industry. Emphasis is on the principles of avian biology and their application in the various facets of poultry production.

250 Dairy Cattle Fall. 3 credits. S-U grades optional.
Lecs, T R 10:10; lab, M T R 1:25–4. D. M. Galton.
Introduces the major components of the dairy industry. Topics discussed include breeding, feeding, reproduction, milking, milk secretion, replacement rearing, disease prevention, and record keeping. Laboratories are designed to provide limited practice in animal husbandry techniques.

251 Dairy Cattle Selection Spring. 3 credits. Prerequisite: Animal Science 250 or equivalent.
Lab, W 12:20–4:25. 1 all-day S field trip.
D. M. Galton.
Emphasis on economical and type traits to be used in the selection and evaluation of dairy cattle. Practical sessions include planned trips to dairy herds in the state.

265 Horses Spring. 3 credits. Prerequisite: Animal Science 100 or permission of instructor. S-U grades optional.
Lecs, T R 10:10, lab, R 1:25–4:25. H. F. Hintz, J. E. Lowe.
Selection, management, feeding, breeding, and training of light horses.

290 Meat and Meat Products Spring. 3 credits.
Lecs, T R 9:05; lab, M T or W 1:25–4:25.
J. R. Stouffer.
An introduction to meat science through a study of the characteristics of meat from slaughter to consumption. Structure, composition, inspection, grading, preservation, cutting, and processing are included. An all-day field trip to commercial meat plants is taken.

321 Seminar on Genetics of the Horse Spring. 1 credit. Prerequisite: Animal Science 265 or permission of instructor. Recommended: Animal Science 221 or Biological Sciences 281.
T or W 9:05. L. D. VanVleck.
A discussion of genetics of the horse, with special reference to simply inherited traits and selection for quantitative traits.

[330 Commercial Poultry Production Fall. 1 credit. Prerequisite: Animal Science 100, 230, or permission of instructor. Offered alternate years. Not offered 1982–83.
F 2–4:25. Field trips. D. L. Cunningham.
The course emphasizes production and business management aspects of commercial poultry farm operation and is designed to acquaint the student with current technology involved in commercial poultry production]

331 The Chicken in Biological Research Fall. 2 credits. Prerequisite: one year of biology.
Lecs, T R 11:15. A. van Tienhoven and staff.
Faculty members will present lectures on the use of the chicken in biological research in the past and present and will supervise preparation of seminars to be given by students on the future use of the chicken in biological research.

340 Systems Analysis in Animal Production Fall. 2 credits. Prerequisite: Animal Science 100. Recommended: Animal Science 250 or equivalent.
Lecs, T R 10:10. P. A. Oltenacu.
All-embracing systems concepts are applied to animal production management. The emphasis is on the principles and techniques needed in decision-making activities with examples of tactical decisions (short term) and strategic decisions (long term) from dairy herd management.

360 Beef Cattle Spring. 3 credits. Prerequisite: Animal Science 100, 110, 220, 221, or permission of instructor.
Lecs, T R 10:10; lab, W R 2–4:25. M. L. Thonney.
Emphasis is on the management of reproduction, nutrition, and selection in beef cattle enterprises. A cattle growth model is studied. Laboratories acquaint students with the management skills of a beef operation. Students are required to spend several days during the semester feeding, observing calving, and caring for cattle. One all-day field trip is taken to visit beef operations in central New York.

370 Swine Production Fall. 3 credits. Limited to 85 students; each lab limited to 45 students. Prerequisite: Animal Science 112, 220, 221 or permission of instructor.
Lecs, T R 11:15; lab, T or W 2–4:25. R. D. Boyd.
The objective is to provide an opportunity to acquire practical knowledge and a technical basis for decisions in various types of swine enterprises. Emphasis on the various production systems, selection and breeding programs, reproductive management, nutrition, herd health and housing facilities. Laboratories are designed to extend and apply principles discussed in lecture and to provide students with the opportunity to apply management skills.

380 Sheep Fall. 3 credits. Prerequisite: Animal Science 100. Recommended: Animal Science 112, 220, and 221.
Lec, T R 10:10; lab and disc periods, M 1:25–4:25 every other week. D. E. Hogue.
The breeding, feeding, management, and selection of sheep. Lectures and laboratories are designed to give the student a practical knowledge of sheep production as well as the scientific background for improved practices.

390 Meat Animal and Carcass Evaluation Fall. 2 credits. Prerequisite: Animal Science 100 or permission of instructor.
Lec and lab, W 2–4:25. J. R. Stouffer, R. D. Boyd, D. E. Hogue, M. L. Thonney.
Principles and techniques of meat animal and carcass evaluation. Grading standards, meat quality, and yield factors and criteria used to evaluate growth, development, and fattening are covered in lectures and demonstrations.

400 Livestock Production in Warm Climates Spring. 3 credits. Prerequisite: either Animal Science 112, 220, or 221 or permission of instructor.
Lecs, T R 9:05, disc W 1:25–3:20. R. E. McDowell.
An analysis of the limitations the tropical environment imposes on livestock production; restrictions on contributions of animals to farm incomes owing to limitations in genetic potential; feed resources; and social structures. The role of animals on small farms and the interdependence of humans and animals for food, services, and nonfood products are stressed. The application of principles introduced in lectures is examined through discussions, problem solving, and independent study.

401 Dairy Production Seminar Spring. 1 credit. Limited to juniors and seniors.
Disc, M 7:30 p.m. D. E. Bauman.
Students, with the help of faculty members, complete a study of the research literature on topics of current interest in the dairy industry. Students make oral and written reports.

402 Undergraduate Seminar Spring. 1 credit. Limited to juniors and seniors. May be repeated. S-U grades optional.
Hours to be arranged. L. D. VanVleck and staff.
Review of literature pertinent to topics of animal science or reports of undergraduate research and honors projects. Students present oral and written reports.

[403 Forages of the Tropics for Livestock Production Spring. 3 credits. Limited to seniors and graduate students except by permission of instructor. Prerequisites: crop production and livestock nutrition. Offered alternate years. Not offered 1982–83.
Lecs, T R 12:20; disc, T 1:25. V. E. Gracen, R. E. McDowell, P. J. VanSoest.
A review of tropical grasslands, sown pastures, and fodders and their use as feed resources; grass and legume characteristics; establishment and management of pastures and feed source alternatives; forage quality and utilization; problems of utilization of tropical forages as hays and silages.]

410 Principles of Animal Nutrition, Lectures Fall. 3 credits. Prerequisite: organic chemistry. Recommended: biochemistry or concurrent registration in a biochemistry course.
M W F 8; 2 discs to be arranged. C. C. McCormick.
A fundamental approach to nutrition focusing on the metabolism as well as the biochemical and physiological function of the known nutrients. The basic principles of nutrition are elaborated with examples drawn from a broad range of animal species including humans. Emphasis is also directed toward nutritional techniques and the application of the topics covered.

411 Principles of Animal Nutrition, Laboratory Fall. 1 credit. Limited to 20 students. Prerequisite: concurrent registration in Animal Science 410.
Hours to be arranged. R. G. Warner, R. E. Austic, R. D. Boyd, L. E. Chase, G. F. Combs, Jr.,

H. F. Hintz, C. C. McCormick, H. F. Schryver, M. L. Thonney.
Lab problems with animals introduce the student to techniques of experimental nutrition.

415 Poultry Nutrition Spring. 1 credit. Prerequisite: Animal Science 410 or permission of instructor.
F 11:15. G. F. Combs, Jr.
A practical consideration of principles of nutrition applied to feeding poultry, including use of linear programming techniques in diet formulation.

419 Animal Cytogenetics Fall. 4 credits. Prerequisites: Animal Science 221, Biological Sciences 281, or permission of instructor.
Lec, T R 9:05; lab, T or W 1:25–4:25; 2 other hours to be arranged. S. E. Bloom.
A study of normal and abnormal chromosomes in higher animals. Lecture topics include chromosome organization, chromosome movement, cytogenetics of abortuses, parthenogenesis, chromosomes and cancer, mitotic and meiotic errors, and human clinical cytogenetics. In laboratories, students obtain chromosome preparations from various animals and use cytochemical and photographic methods for karyotype analysis.

420 Quantitative Animal Genetics Fall. 3 credits.
Lecs, T R 11:15; lab, W R or F 2–4:25.
L. D. VanVleck.
A consideration of problems involved in improvement of animals, especially farm animals, through application of the theory of quantitative genetics with emphasis on selection index.

421 Seminar in Animal Genetics Fall. 1 credit. Prerequisite: Animal Science 221 or concurrent registration in Animal Science 420.
Hours to be arranged. L. D. VanVleck, R. W. Everett.
A discussion of applications of principles of quantitative genetics and animal breeding to specific types of animals such as dairy animals, meat animals, and horses.

422 Research Techniques in Quantitative Animal Genetics Fall. 1 credit. Prerequisite: Animal Science 420 or concurrent registration in Animal Science 420.
R 12:20. L. D. VanVleck.
An introduction to methods of research in quantitative genetics and animal breeding, including estimation of heritability, repeatability, and genetic and phenotypic correlations.

427 Fundamentals of Endocrinology Fall. 3 credits. Prerequisite: human or veterinary physiology, or permission of instructor.
Lecs, M W F 9:05. W. R. Butler.
The physiology of the endocrine glands and the roles played by each hormone in the regulation of normal body processes. Endocrine regulation of growth, metabolism, and reproduction is emphasized. Examples are selected from domestic species and humans.

428 Fundamentals of Endocrinology, Laboratory Fall. 2 credits. Each lab limited to 30 students. Concurrent registration in Animal Science 427 or permission of instructor.
Lab, T or R 1:25–4:25. W. R. Butler.
Laboratory exercises are designed to demonstrate hormonal mechanisms for each of the major endocrine glands. Laboratory techniques include animal surgery, blood collection, and hormone radioimmunoassay.

430 Artificial Breeding of Farm Animals Fall, starting August 18. 2 credits. Prerequisites: Animal Science 220 and 221 or their equivalent. Permission of instructor must be obtained at course enrollment.
Lecs, T R 9:05 first seven weeks. Labs: M T W R F 8:30–4:30; sec 1, Aug. 18–24; sec 2, Aug. 25–31. R. H. Foote.
Principles of artificial breeding and practical animal and laboratory experience in semen collection, semen evaluation, semen freezing, and artificial insemination of farm animals.

450 Immunophysiology Spring. 3 credits. Prerequisite: course work in immunology and animal physiology or permission of instructor.
Lecs, M W F 11:15. J. A. Marsh.
Emphasis on the development and regulation of the immune system and the physiological parameters affecting and affected by immune functioning. Major topics include development immunology, immunoregulation, immunological involvement in reproduction and gonadal function, interrelationships between immune and endocrine functioning, and the immunology of aging. Other topics include tumor and transplantation immunology and autoimmune disease.

451 Physiology and Biochemistry of Lactation Spring. 3 credits. Prerequisite: either Animal Science 220 and Biological Sciences 231 or permission of instructor.
Lecs, T R 9:05; lab, R 2–4:25. R. C. Gorewit.
Emphasis is on mammary gland development, anatomy, physiological control of milk secretion, and biochemical synthesis of milk constituents in laboratory and farm animals.

452 Comparative Physiology of Reproduction of Vertebrates (also Biological Science 452) Spring. 3 credits. Prerequisite: Animal Science 427 or permission of instructor.
Lecs, M W F 1:25. One prelim at 7:30 p.m.
A. van Tienhoven.
Sex and its manifestations. Neuroendocrinology of reproduction, sexual behavior, gametogenesis, fertilization, embryonic development, care of the zygote environment and reproduction, immunological aspects of reproduction.

454 Comparative Physiology of Reproduction of Vertebrates, Laboratory (also Biological Sciences 454) Spring. 2 credits. Prerequisite: Animal Science 452, concurrent registration in Animal Science 452, or permission of instructor.
Hours to be arranged; organizational meeting F 2:30 first week of semester. A. van Tienhoven.
Provides students with an opportunity to independently design and execute experiments with limited objectives.

455 Dairy Herd Management Spring. 4 credits. Prerequisite: Animal Science 112, 220, 221, 250 or equivalents. Recommended: Agricultural Economics 302.
Lecs, M W F 11:15; Lab, M T 1:25–4:25; one all-day field trip. W. G. Merrill and staff.
Application of scientific principles to practical herd management, analyses of alternatives, and decision making. Laboratories, including farm visits, emphasize practical applications, problem solving, and discussion.

486 Immunogenetics (also Biological Sciences 486) Spring. 4 credits. Limited to 25 students. Prerequisites: a course in immunology and Animal Science 221 or Biological Sciences 281, or permission of instructor.
Lecs, M W F 10:10; disc, W or R 12:20.
R. R. Dietert.
The genetic control of a variety of cellular antigens and their use in understanding biological and immunological functions. The genetics of antibody diversity, antigen recognition, immune response, transplantation, and disease resistance.

490 Commercial Meat Processing Fall. 3 credits. Prerequisite: Animal Science 290 or permission of instructor.
Lecs, T R 9:05; lab, T or R 1:25–4:25. Field trip to commercial meat processing plants.
D. H. Beermann.
A study of the classification, formulation, and production of commercially available processed meat products. Physical and chemical characteristics of meat and nonmeat ingredients; their functional properties; various methodologies; microbiology; packaging, handling, and storage; and quality assurance are discussed.

497 Special Topics in Animal Sciences Fall or spring. 3 credits maximum. Intended for students in animal sciences. Prerequisite: permission of instructor. S-U grades optional.
Staff.
May include individual tutorial study or a lecture topic selected by a professor. Since topics may change, the course may be repeated for credit.

498 Undergraduate Teaching Fall or spring 1 or 2 credits; 4 credits maximum during undergraduate career. Limited to students with grade point averages of at least 2.7.
Designed to consolidate the student's knowledge. A participating student assists in teaching a course allied with the student's education and experience. The student is expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

499 Undergraduate Research Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with grade averages of at least 2.7.
Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

600 Research Fall or spring. Credit to be arranged.
Hours to be arranged. All members of animal science program area.

601 Proteins and Amino Acids in Nutrition (also Nutritional Sciences 601) Fall. 2 credits. Prerequisites: physiology, biochemistry, and nutrition, or permission of instructors.
W F 11:15. R. E. Austic, M. Morrison.
An advanced course in amino acid and protein nutrition, with emphasis on the dynamic aspects of protein digestion, amino acid absorption, protein synthesis, amino acid metabolism, and nitrogen excretion. Discussions include nutritional interrelationships, amino acid and protein requirements, assessment of nutritional status, evaluation of protein quality, bioavailability of amino acids, and techniques of amino acid analysis. Emphasis is on basic principles and their application in animal and human nutrition.

604 Vitamins Fall. 2 credits.
T R 10:10. G. F. Combs, Jr.
A discussion of the chemistry, biochemistry, and physiological functions of the vitamins, with emphasis on nutritional aspects.

605 Forage, Fiber, and the Rumen Spring. 4 credits. Prerequisites: either general nutrition and biochemistry or permission of instructor.
M W F 12:20; disc, W 11:15 or F 1:25.
P. J. Van Soest.
Ruminant nutrition; lower-tract fermentation in monogastrics; nutritional biochemistry of forage plants, fiber, and cellulosic material.

[607 Microbiology of the Rumen Spring. 3 credits. Prerequisites: general biochemistry, microbiology, and nutrition or permission of instructor. Not offered 1982–83.
Lecs, M W F 10:10. J. B. Russell.

Nutrition, biochemistry, physiology, taxonomy, and ecology of rumen bacteria and protozoa. Effects of rumen microbial ecology on ruminant nutrition. Manipulation of rumen fermentations to maximize host-animal performance.]

609 Seminar in Poultry Biology Fall or spring. Limited to graduate students. S-U grades only.
Hours to be arranged. Staff.
A survey of recent literature and research in poultry biology.

610 Seminar Fall and spring. 1 credit. Required of all graduate students with a major or minor in animal science. S-U grades only.
M 11:15. Department faculty.

613 Forage Analysis Spring: 2 credits. Prerequisite: permission of instructor.
Lab, R 2–4. P. J. Van Soest.
Chemical composition and nutritive evaluation of forage plants and related materials. The course includes a term paper summarizing results of independent laboratory study of either materials or methods.

619 Field of Nutrition Seminar Fall or spring. Noncredit.
M 4:30.
Current research in nutrition is presented by visitors and faculty.

620 Seminar in Animal Breeding Fall or spring. 1 credit. Limited to graduate students with a major or minor in animal breeding. S-U grades only.
Hours to be arranged.

621 Seminar in Reproductive Physiology Fall and spring. 1 credit. Registration limited to graduate students. Advanced undergraduates welcome to attend. S-U grades only.
W 4:30. R. H. Foote and staff.
Current research in reproductive physiology is presented by staff members, graduate students, and visitors.

640 Special Topics in Animal Science Fall or spring. 1 or more credits.
Hours to be arranged. Staff.
Study of topics in animal science more advanced than, or different from, other courses. Subject matter depends on interests of students and availability of staff.

720 Experimental Methods in Quantitative Genetics and Animal Breeding Spring. 3 credits. Prerequisites: matrix algebra, linear models, and mathematical statistics.
Hours to be arranged. R. L. Quaas.
Estimation of genetic and environmental parameters required to design efficient selection programs. Emphasis is given to interpretation of experimental and survey data with unequal subclass numbers, and prediction of genetic progress resulting from alternative selection methods.

Related Courses in Other Departments

Introductory Animal Physiology (Biological Sciences 311)

Introductory Animal Physiology Laboratory (Biological Sciences 319)

Milk Quality (Food Science 351)

Special Studies of Problems of Livestock Production in the Tropics (International Agriculture 602)

Lipids (Nutritional Sciences 602)

Poultry Hygiene and Disease (Veterinary Medicine 255)

Basic Immunology, Lectures (Veterinary Medicine 315)

Basic Immunology, Laboratory (Veterinary Medicine 316)

The Population Biology of Health and Disease (Veterinary Medicine 330)

Health and Diseases of Animals (Veterinary Medicine 475)

Biological Sciences

The program of study in biology is offered by the Division of Biological Sciences. For course descriptions, see pp. 206–220.

Communication Arts

N. E. Awa, H. Cogan, R. D. Colle, B. O. Earle, S. Engstrom, C. H. Freeman, G. Gay, D. A. Grossman, J. E. Hardy, J. Knapp, J. E. Lawrence, R. D. Martin, R. E. Ostman, T. M. Russo, D. F. Schwartz, M. A. Shapiro, R. E. Shew, V. R. Stephen, P. Stepp, R. B. Thompson, W. B. Ward, S. Warland, S. A. White, A. M. Wilkinson

114 Writing in the Biological Sciences Fall or spring. 3 credits. Freshman Seminar designed for College of Agriculture and Life Sciences students. Concurrent registration is required in Biological Sciences 101–102, 103–104, 105–106, or 109–110.
Lec, M W F 9:05. A. M. Wilkinson and staff.
Factual, informative writing based on information and laboratory experiences in biology. Emphasis on writing rather than subject matter and on objective observation rather than subjective personal experience. Discussion of effective sentence and paragraph structure, organization, grammatical structure and usage, meaning of words, and punctuation. Objective is clear, concise, concrete writing.

150 Writing for Media Fall. 3 credits. Limited to communication arts freshmen and first-year transfer students.
Lec, T 8; disc, W 12:20–2:15 or 2:30–4:25.
M. A. Shapiro.
Basic writing for print and broadcast. A back-to-basics approach to writing for clarity and style, using news and feature writing as a framework. Media form and style are analyzed. Frequent writing assignments, both in and outside of class, are given.

200 Theories of Human Communication Fall or spring. 3 credits. S-U grades optional. Not open to first-semester freshmen.
Lecs, T R 12:20; disc, T or R 1:25. R. B. Thompson and staff.
An introduction to human communication from a multidisciplinary perspective. Contributions from philosophy, psychology, neurology, social psychology, linguistics, anthropology, and communication theory are considered.

205 Parliamentary Procedure Fall or spring. 3 credits. Limited to 40 nonfreshman students each section. No students accepted after the second week of classes. Letter grades only.
Lec, M 12:20; disc, T 2:30–4:25 or R 2:30–4:25.
R. D. Martin.
A detailed study of the principles and rules of parliamentary procedure using *Robert's Rules of Order,* newly revised, as the text. Emphasis on practical experience and the importance of a well-run meeting as an integral component of effective communication. Includes outside-meeting evaluations; preparation of bylaws; and practice in serving as a presiding officer, secretary, and committee member in a simulated meeting situation.

215 Introduction to Mass Media Fall or spring. 3 credits. Limited to 125 nonfreshman students. S-U grades optional.
Fall: lecs, W F 1:25; disc, M 1:25. Spring: lecs, W F 11:15; disc, M 11:15. R. E. Ostman.
History, processes, philosophies, policies, and functions of United States communication media. Each major medium is examined individually in regard to information processing and persuasion. Effects of messages, regulation of media, and other contemporary issues are examined.

230 Visual Communication Fall. 3 credits. Limited to 100 nonfreshman and communication arts freshman students. Not recommended for art or design majors. Project materials cost about $15–$25.
M W F 9:05. V. R. Stephen.
A basic course in the use and importance of visual communication methods and materials in today's society. Posters, charts, displays, photographs, slides, overhead projection, motion pictures, and television are among the topics discussed. Practical projects are assigned.

231 Art of Publication Spring. 3 credits. Limited to 30 communication arts students. Project materials cost about $25–$45.
M or W 1:25–4:25. Staff.
A basic course designed to explore visual concepts that increase communication effectiveness through the printed word. The importance of selecting and coordinating format, layout, typography, and illustrations is stressed. Lectures, a field trip, in-class assignments, and three outside projects examine opportunities and problems in publication design and production.

301 Oral Communication Fall, spring or summer. 3 credits. Each section limited to 24 sophomores, juniors, and seniors. Students missing the first week of classes without a University excuse are dropped so that others may register. No students accepted or allowed to drop after the second week of classes. Letter grades only.
Disc, M W F 8, 9:05, 10:10, or 11:15; M T W 1:25; M W 9:05 and T 12:20; T R 9:05 and W 12:20; T R 9:05 and W 1:25; T R 10:10 and M 1:25; T R 10:10 and W 12:20; T R 10:10 and W 1:25; T R 10:10 and W 2:30; T R 11:15 and W 12:20; T R 11:15 and W 1:25; T R 11:15 and W 2:30. B. O. Earle, R. D. Martin, T. M. Russo, P. Stepp, R. B. Thompson, and staff.
A study of the basic process and principles of oral communication. Through theory and practice, the student is encouraged to develop self-confidence and competence in public speaking. Provides experience in preparing, delivering, and evaluating oral presentations.

302 Persuasion Fall or spring. 3 credits. Prerequisite: Communication Arts 301.
Lec, M 11:15; discs, T R 11:15 or 12:20 or W F 11:15. B. O. Earle.
The course concentrates on the analysis and understanding of the persuasion events around us. The oral presentations stress the application of various theories of persuasion to the interpersonal communication process.

303 Small Group Communication Fall. 3 credits. Limited to juniors and seniors. Prerequisite: Communication Arts 200 or permission of instructor.
T R 2:30–4. N. E. Awa.
Theory and practice in leadership and participation in small-group communication. The course examines the values and limitations of group discussion, collaborative behavior, and conflicts in a democracy.

304 Effective Listening Fall or spring. 3 credits. Limited to 25 nonfreshman students per section. No student accepted after the second week of classes. Letter grade only.
Lec 1, M 1:25; disc 1, W 12:20–2:15 or lec 2, T 10:10; disc 2, R 10:10–12:05. R. D. Martin.

Lecture, discussion, and demonstrations are used to present an analysis of the process of listening, including barriers to effective listening and techniques for improving listening skills. Students will participate in frequent skill-building exercises and tests of listening involving comprehension and retention.

[311 Radio and Television Communication Fall. 3 credits. Not offered 1982–83.
M W F 10:10. R. D. Colle.
An overview of the roles of radio and television in contemporary society, with particular emphasis on the development, organization, and influence of these media in the United States. Attention is also given to the structure and uses of radio and television in other nations, to provide perspective on the systems here, and to the techniques and constraints involved in program production.]

312 Advertising and Promotion Fall, spring, or summer. 3 credits. In the fall, limited to junior and senior communication arts majors and graduate students. In the spring, for juniors, seniors, and graduate students not majoring in communication arts. S-U grades optional.
Fall: M W 2:30–4:25. Spring: M W 2:30–4. Staff.
In the fall, the course emphasizes the planning, creation, production, and measuring of advertisements and advertising campaigns. Lectures and workshops alternate. In the spring, the emphasis is on the role of advertising and promotion in society —how advertising evolved, forms of advertising, research, creative strategies, media, advertising regulations, testing, and advertising organizations. Lectures only, including guest lecturers.

315 Basic Newswriting for Newspapers Fall and spring. 3 credits. Limited to 30 students. Prerequisite: major in communication or permission of instructor. Typing ability is essential.
R 1:25–4:25. R. E. Shew, director, News Bureau, Cornell University.
Writing and analyzing news stories. A study of the elements that make news, sources of news, interviewing, writing style and structure, press problems, and press-society relations. Concentration on newswriting as it is practiced by newspapers in the United States. Two writing assignments each week, one done in class, one done out of class.

316 Science Writing for the Mass Media Fall and spring. 3 credits. No drops after third week.
Fall: lec, R 12:20; disc, T 12:20–2:15. Spring: lec, T 12:20; disc, F 12:20–2:15. M. Shapiro.
Writing to explain and simplify scientific and technical topics for newspaper and magazine readers, radio listeners, television viewers, and educational-material consumers. Includes frequent writing assignments. Final projects include writing a newspaper or magazine article, writing a radio program, and writing and producing a television program. Students learn interviewing and research methods that ensure technical accuracy. Students should become familiar with the public policy and institutional milieu that have an effect on science writing and should reflect that knowledge in their writing.

318 Radio Writing and Production Spring. 3 credits.
T 1:25–4:25. J. E. Lawrence.
Scripting and recording various public information formats for possible use on local and state radio stations. Students create complete broadcasting plans and materials for public and private organizations.

319 Television Writing and Production Spring. 3 credits. Limited to 25 students. S-U grades optional.
T R 8–9:55. J. E. Lawrence.
Creation of television information programs, from development of idea through research, scripting, and production.

331 Survey Research Methods Spring. 3 credits. Limited to 20 junior, senior, or graduate majors; others by permission of instructor. Prerequisites: Communication Arts 200, 215, or permission of instructor. S-U grades optional.
M W F 10:10. R. E. Ostman.
Analysis of public opinion polls, market research, media audience ratings, communication strategy planning, and message research. Development of class research project from research question to final report. Instruction in computer use of Statistical Package for the Social Sciences (SPSS) to assist in data analysis. Familiarity with basic statistical concepts helpful.

360 Scientific Writing for Public Information Fall or spring. Not open to freshmen. 3 credits.
Fall: T R 9:05 and W 11:15. Fall or spring: T R 10:10 and W 12:20; M W F 9:05 or 10:10.
J. E. Hardy and staff.
An intensive course in simplifying scientific and technical material for specific audiences within the general public. Weekly assignments include instructions, descriptions, explanations, and summaries in such formats as the newsletter, brochure, and report. Audience analysis will be emphasized. Not oriented to the mass media.

363 Organizational Writing Fall or spring. Not open to freshmen. 3 credits.
M W F 9:05 or 1:25. Staff.
Students write as members of different organizations, in the position of supervisor, subordinate, colleague, and representatives of business, government, community, and other organizations. Emphasis on adapting tone to the audience and the purpose of the message. Weekly writing assignments include various kinds of internal and external reports, memoranda, proposals, and letters. Assignments based on case studies.

365 Writing in the Sciences and Engineering Fall and spring. Permission of instructor required. 3 credits.
Biological sciences section: M W F 10:10; engineering and physical sciences section: T R 10:10 and M 12:20. A. M. Wilkinson and staff.
Students write scientific or technical material for colleagues in their own field. The objective is clear, concise writing, with attention to grammatical construction, usage, paragraph development, and organization. Weekly writing assignments include scientific or technical instructions, descriptions of equipment and procedures, definition and explanation of concepts, graphic presentations and discussion of data, abstract and summary, memorandum, research proposal, progress report, and research report.

368 Editing Spring. 3 credits. Limited to 25 junior, senior or graduate students. Prerequisites: Communication Arts 315, 316, 360, 363, 365, or 413.
W F 10:10–11:25. J. E. Hardy.
Students will follow the process that takes a manuscript from final draft to page proof. Emphasis will be on copy editing, proofreading, fitting copy, working with authors, making editorial decisions, and developing skill in critical reading. Appropriate for any student who expects to work with manuscripts or do editorial work.

375 Principles of Public Communication Fall. 3 credits. Limited to juniors and seniors, or permission of instructor.
M W F 8:00. J. E. Lawrence.
Theory, principles, and practices that guide and influence the solutions to public relations problems in agriculture, business, education, government, and social welfare organizations. Examines the process of image formation, public opinion, and developing favorable relationships with the public. Study of public relations as a professional field.

380 Independent Honors Research in Social Science Fall or spring. 1–6 credits. Limited to undergraduates who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program. Students must use faculty member's section number to register.

401 Communication Law Fall. 3 credits. Limited to junior, senior, and graduate communication arts students; others by permission of instructor.
M W F 11:15. D. A. Grossman.
A practical survey of the law governing mass media, primarily for those working in the field. Coverage includes restraints on news gathering and publication, privacy, defamation, copyright, broadcast licensing, access, and other issues of current interest.

[403 Topics in Communication Theory Fall. 3 credits. Prerequisite: Communication Arts 200 or permission of instructor. Offered alternate years. Not offered 1982–83.
Topics in communication theory, determined by the interest of faculty and students, are discussed.]

404 Psychology of Communication Spring. 3 credits. Prerequisite: Communication Arts 200 or permission of instructor.
T R 10:10–11:25. R. Thompson.
An advanced multidisciplinary study of communication theory. Topics include personal interaction, channels of communication, and effectiveness of messages. Study includes intensive analysis of major communication theories.

410 Organizational Communication Fall. 3 credits. Limited to 25 junior, senior, or graduate communication arts students; others by permission. Prerequisite: Communication Arts 200 or equivalent.
Lec, M W 9:05; disc, F 9:05–11. D. F. Schwartz.
Study of managerial communication practices in formal organizations, with emphasis on communication between supervisor and subordinate; examination of the structure and function of planned and unplanned organizational communication networks; techniques for analyzing management communication systems. Case studies assigned for discussion.

413 Writing for Magazines Fall or spring. 3 credits. Limited to juniors, seniors, and graduate students. No drops after third week.
Fall: M 1:25–4:25; W. B. Ward. Spring: W F 8:15–9:45; M. A. Shapiro.
Intensive fact writing to help students communicate more effectively through the medium of the printed word in magazines. Art and techniques of good writing are studied; magazines in many fields of interest are reviewed. All articles are analyzed and returned to the student to rewrite and submit to a magazine.

420 Print Media Laboratory Fall. 3 credits. Limited to junior, senior, and graduate communication arts majors. Prerequisite: Communication Arts 231, 314, 360, or 413.
R 1:25–4:25. J. E. Hardy, V. R. Stephen.
Writing, editing, and layout principles practiced in publishing the *Cornell Countryman*. Some additional outside work sessions may be required.

[421 Broadcast Media Laboratory Fall. 2 credits. Limited to junior and senior communication arts majors. Prerequisite: Communication Arts 318 or 319. Not offered 1982–83.
R 8. R. D. Colle.
Emphasis on production of television and radio programs for various audiences. Course work is done primarily through individual tutorial arrangement.]

422 Print Media Laboratory Spring. 3 credits. Limited to junior, senior, and graduate communication arts majors. Prerequisite: Communication Arts 231, 314, 360, or 413.

R 1:25–4:25. J. E. Hardy.
A continuation of Communication Arts 420.

[423 Broadcast Media Laboratory Spring. 2 credits. Not offered 1982–83.
Hours to be arranged. J. E. Lawrence.
A continuation of Communication Arts 421.]

440 Photo Communication Fall or spring. 3 credits. Limited to 25 junior and senior communication arts majors; others by permission of instructor. For those with limited experience in photography. Students are expected to furnish their own supplies and cameras. Supplies will cost approximately $60–$70.
T 1:25–4:25. C. H. Freeman.
Basic photography: camera handling, film processing, projection printing, and photographic lighting. Photojournalism is emphasized during the latter part of the course.

460 Video Communication Fall or spring. 2 credits. Limited to 15 seniors or graduate students. Prerequisites: Communication Arts 150, 200, or 230, and permission of the instructor by application.
F 12:20–2:50. G. Gay.
An overview of video communication applications. Examination of relevant organizational and visual communication theory. Development of basic competency with portable videotape recording equipment, audio and visual input to video and production, and postproduction planning and editing techniques.

496 Internship Fall, spring, or summer. 1–6 credits. Students must apply to department internship committee no later than during the spring preregistration period for fall internships, or the fall preregistration period for spring or summer internships. Students must use supervising faculty member's section number to register. Prerequisites: communication arts major, 3.0 GPA, and approval of committee.
V. Stephen and staff.
Structured, on-the-job learning experience under supervision of professionals in a cooperating organization. Students assigned a faculty adviser by department internship committee. Faculty adviser supervises the course and the awarding of credit and grade. A learning contract is written between the faculty adviser and student, stating the conditions of the work assignment, supervision, and reporting. Minimum of 60 on-the-job hours per credit granted. May be repeated to a maximum of 6 credits.

497 Independent Study Fall or spring. 1–6 credits. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade. Students must use the faculty member's section number to register.
Staff.
Group or individual study under faculty supervision. Work should concentrate on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic. Attempts to implement this knowledge in a practical application are desirable.

498 Communication Teaching Experience Fall and spring. 1–3 credits each semester. Limited to juniors and seniors. Intended for undergraduates desiring classroom teaching experience. Prerequisite: permission of the faculty member who will supervise the work and assign the grade. Students must use the faculty member's section number to register.
Hours to be arranged. Staff.
Periodic meetings with the instructor cover realization of course objectives, evaluation of teaching methods, and student feedback. In addition to aiding with the actual instruction, each student prepares a paper on some aspect of the course.

499 Independent Research Fall or spring. 1–6 credits. Limited to senior and graduate students. Seniors must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade. Students must use the faculty member's section number to register.
Staff.
Permits outstanding students to conduct laboratory or field research in communication under appropriate faculty supervision. The research should be scientific: systematic, controlled, empirical. Research goals should include description, prediction, explanation, or policy orientation and should generate new knowledge.

601 Intercultural Communication Spring. 3 credits.
M F 10:10–11:25. N. E. Awa.
A systematic analysis of sociocultural and psycholinguistic obstacles to effective communication between cultures, subcultures, and ethnic and identity groups. Also examined are the subtleties and complexities of nonverbal behavior in cross-cultural transactions. Examples are drawn from ethnolinguistic and cross-cultural studies.

612 Seminar: Interpersonal Communication Fall. 3 credits.
M 1:25–4:25. Staff.
A study of recent advances and research in leadership, small-group interaction, and communication networks. New developments are examined as they relate to business, administration, and education.

614 Scientific Writing for Scientists Fall or spring. 3 credits. Prerequisites: research in progress and permission of the instructor.
T R 8:30–9:55. A. M. Wilkinson.
Workshop for students with research in progress. Discussion and lectures on writing a journal article, thesis, report, and proposal; on objectives in scientific writing, relation of rhetoric and linguistics to scientific writing, process of publication and reviewing, preparation of tables and illustrations; and on advanced and special problems in organization, paragraph development, sentence structure, and usage.

620 Communication in Organizations Fall. 3 credits. Prerequisite: permission of instructor.
W 1:25–4:25. S. A. White.
Review of theories, research, and practical systems as they relate to human communication effectiveness in organizations. Includes components of interpersonal communication, intragroup and intergroup communication, communication processes involved in organizational goal setting, renewal and change.

[624 Communication in the Developing Nations Spring. 3 credits. Limited to seniors and graduate students. Not offered 1982–83.
T R 12:20–1:35.
An examination of existing communication patterns and systems and their contributions to the development process. Attention is given to the interaction between communication development and national development in primarily agrarian societies.]

631 Studies in Communication Fall. 3 credits. Limited to graduate students in communication arts; others by permission of instructor.
T R 10:10–11:25. N. E. Awa.
A review of classical and contemporary research in communication, including key concepts and areas of investigation. An exploration of the scope of the field and the interrelationships of its various branches.

632 Methods of Communication Research Fall. 3 credits. Limited to graduate students.
M W 10:10–11:25. R. E. Ostman.
An analysis of the methods used in communication research. Emphasis is on understanding the rationale for experimental, descriptive (empirical and nonempirical), and historical-critical research methods.

640 Seminar in Organizational Communication Spring. 3 credits. Open to seniors by permission.
W 1:25–4:25. S. A. White, W. Frank.
Communication functions and systems in business, industry, labor, education, etc., from the perspectives of academic authorities and managers. Development of conceptual schemes for analyzing components of organizational and human communication effectiveness.

643 Frontiers in Communication Fall. 3 credits.
T R 8:30–9:55. R. D. Colle.
A study of recent developments in communication. Emphasis is on the application of the new methods, materials, and technology in visual, print, film, oral, and telecommunication media to contemporary and future problems significantly involving communication.

650 Advanced Communication Seminar Fall or spring. 3 credits. Primarily for graduate students but open to seniors.
W 10:10–12:45. R. D. Colle.
An analysis of communication problems faced by various kinds of public and private sector organizations. Using case studies, the course explores some of the major components of communication strategies, particularly as they relate to communication planning. Examples are drawn from corporate communication programs, nutrition and health nonformal education projects, rural development programs, and government public information campaigns.

651 Seminar: Communication Issues Fall and spring. Noncredit. S-U grades only.
Alternate Fridays, 2:30. Staff.
The seminar deals with contemporary issues in communication, especially those related to the use of mass media as sources of information and influence, organizational communication, and intercultural communication.

690–691 Communication Teaching Laboratory Fall and spring. 1–3 credits each semester. Limited to graduate students. Prerequisite: permission of the faculty member who will supervise the work and assign the grade. Students must use the faculty member's section number to register.
Hours to be arranged.
Designed primarily for graduate students who want experience in teaching communication courses. Students work with an instructor in developing course objectives and philosophy, planning, and teaching.

760 Advanced Communication Projects Fall or spring. 3 ccedits. Limited to communications arts graduate students. May not be repeated. Students must use the faculty member's section number to register.
Staff.
Independent studies and projects are carried out in conjunction with selected undergraduate courses.

895 Directed Graduate Study Fall or spring. 3–6 credits. S-U grades only. Students must use the faculty member's section number to register.
Staff.

Education

J. P. Bail, chairman; A. L. Berkey, G. J. Broadwell, R. L. Bruce, J. L. Compton, H. R. Cushman, W. E. Drake, J. A. Dunn, J. R. Egner, R. B. Fischer, H. A. Geiselmann, M. D. Glock, D. B. Gowin, E. J. Haller, D. E. Hedlund, J. Millman, D. H. Monk, J. D. Novak, G. J. Posner, R. E. Ripple, V. N. Rockcastle, K. A. Strike, H. D. Sutphin, R. W. Tenney, H. L. Wardeberg

110 Introduction to Psychology Fall and spring 4 credits.
Lecs, M W F 10:10; 1 disc sec to be arranged. D. E. Hedlund.
Survey of the major areas of psychological inquiry with emphasis on the personal application of psychological knowledge to the problems of living and to current social issues, including how to be an intelligent consumer of psychological research.

240 The Art of Teaching Spring. 3 credits.
Lec, T.2:30–4; labs to be arranged. G. J. Posner.
This course is designed for all students interested in finding out more about teaching. Teaching is considered an activity in which people of many occupations engage, not limited to schools. Students engage in field experiences to find out what teaching involves (minimum of 2 hours a week). Class and laboratory work builds on this experience and provides skills and concepts to make the field experience more profitable.

[271 (371) Sociology of Education Spring. 3 credits. S-U grades optional. Not offered 1982–83.
T R 10:10–11:30. E. J. Haller.
An introduction to the sociological study of schooling and education. Topics include the effects of social factors on educational achievement, the norms and values learned as part of the process of schooling, the relations between students and teachers, and the school's relations to the economic and political systems. All levels of education, from elementary school to the university, are considered.]

311 Educational Psychology Fall or spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional.
Fall, M W F 11:15; R. E. Ripple. Spring, M W F 9:05; M. D. Glock.
An introductory survey course. Emphasis is on human learning and the educational process from a psychological point of view. The course is set in a broadly based teaching-learning context appropriate for prospective teachers, youth group leaders, community leaders, and those in the service-helping professions.

312 Learning to Learn Spring. 3 credits. Prerequisite: one or more courses in psychology or educational psychology.
T R 1:25. J. D. Novak.
This course is intended for persons interested in the improvement of educational programs through the application of new knowledge in learning theory. Lectures and discussions are based on assigned readings and the contributions of class members. The major focus of the course is how and why concepts play a central role in human learning. Concept mapping and other strategies for educating will be used.

317 Psychology of Adolescence Spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional.
T R 12:20–1:25. R. E. Ripple.
A survey of the nature of adolescent development, with emphasis on causal factors of adolescent behavior. Focus is on an examination of the interrelationships among the major aspects of adolescent development, an examination of some of the dominant themes of adolescence, acquaintance with research on adolescent development, and implications for the educational process.

331 Introduction to Teaching Agriculture Spring. 2 credits. Required of persons who plan to enter the student teaching program.
Lec, M 2–4:25; lab to be arranged. W. E. Drake.
An introduction to the origin, development of curricula, and methods of teaching agriculture in secondary schools. Purposes are (1) to provide exploratory experience as agricultural educators in teaching, extension, and other professions, and (2) to prepare prospective teachers for participation in the resident student-teaching program leading to teacher certification.

335 Youth Organizations Spring. 3 credits. Prerequisite: introductory psychology.
Lecs, T R 10:10; lab to be arranged. R. W. Tenney.
The role of selected youth organizations in providing educational experiences for youth. Factors affecting membership, purposes, design, operation, and administration are surveyed, emphasizing the roles the adult volunteer leader may play. The course is designed to give the student an in-depth, learning-by-doing experience of how youth organizations function. Field experience with a recognized youth organization is required.

340 Theories of Teaching Fall. 3 credits.
M W 2:30–3:45. G. J. Posner, K. A. Strike.
This course is intended to assist the student in conceptualizing the process and contexts of teaching in school and nonschool settings. The course examines representative theories of teaching and provides an opportunity for students to develop their own views.

352 Reading Statistics Fall or spring. 1 credit. Prerequisite for spring: concurrent registration in Education 353.
Fall: T 12:20. Spring: T R 8:30–9. J. Millman.
An introduction to statistical vocabulary and symbolism frequently used in reporting empirical research in education and other social sciences. Students are taught how to comprehend statistical terminology and results.

353 Introduction to Educational Statistics Spring. 3 credits. Prerequisite: Education 352 or concurrent registration in Education 352, or permission of instructor.
T R 9:05–11. J. Millman.
A study of common univariate and multivariate statistical procedures encountered in educational and psychological inquiry. Microcomputers and minicomputers are used to explain statistical concepts and to compute statistical indices. A mastery learning-teaching style is employed.

370 Issues in Educational Policy Spring. 3 credits.
M W F 10:10. K. A. Strike.
An examination of the social, political, and economic issues that affect teaching and learning in schools and other settings. Included are such issues as educational opportunity, governance and policymaking, school and community, the economics of education, and the teacher in a social context.

378 Economics of Education Fall. 3 credits. S-U grades optional.
T R 10:10–11:30. D. H. Monk.
An introduction to the use of economic principles to study education and educational policy. Specific attention is given to the impact of education on economic growth, the distribution of earnings, and characteristics of the labor force. The concept of human capital is introduced and developed as a means of understanding these phenomena. Techniques of cost-benefit and cost-effectiveness analysis are used to shed light on current controversies regarding the effectiveness of alternative types of schooling. No formal training in economics is presupposed.

380 Independent Honors Research in Social Science Fall or spring. 1–6 credits. Limited to students who have met requirements for the honors program. S-U grades optional. A maximum of 6 credits may be earned in the honors program.
Staff.

401 Our Physical Environment Fall or spring. 3 credits. Prerequisite: permission of instructor. Charge for lab supplies, approximately $7.
T 1:25–4:25. V. N. Rockcastle.
A practical, relatively nonmathematical study of some basic relationships and physical interactions in the environment, with emphasis on physics and earth science. Attention is paid to analysis for understanding and techniques for teaching. A two-week session on photography and an individual research project are included. Useful for teachers and environmental educators.

403 Environmental and Natural History Writing Spring. 3 credits. Limited to upperclass and graduate students. Prerequisites: a course in composition, working knowledge of biology and ecology, permission of instructor.
W 7:30–10 p.m. R. B. Fischer.
For those who want to develop skills in changing environmental attitudes and behavior using newspapers, magazines, and radio. The class produces a weekly environmental awareness column for a local newspaper and records scripts for a weekly radio program.

404–405 Field Natural History Fall and spring. 3 credits each semester. Limited to upperclass and graduate students. Prerequisites: basic biology and ecology and permission of instructor. Education 404 is not a prerequisite to 405.
Fall: lec, M 10:10; labs, M R 1:25–4:30. Spring: lec, M 10:10; lab, M 1:25–4:30. R. B. Fischer.
This course provides students who plan to be professional environmental interpreters and educators with methods and materials for sensitizing people about the complexity and fragility of their living environment. It provides practical experiences in teaching about the environment in a variety of classroom and out-of-classroom settings.

407 Teaching Elementary Science Fall. 3 credits.
W 1:25–4:25. V. N. Rockcastle.
An analysis and synthesis of science concepts and related behaviors for children and young adults, with emphasis on sequencing and instruction in school and environmental centers. Includes practical experiences in local schools and youth centers.

411 Educational Measurement Fall. 3 credits Prerequisite: permission of instructor.
W 3:35–6. M. D. Glock.
Demonstrations of administration for procedural tests. Construction of achievement tests and use of other measuring instruments in classification and guidance for improvement of instruction. Emphasis is on the use of formal and informal instruments.

413 Psychology of Human Interaction Fall. 3 credits. Fee, $5.
T R 10:10–12:05. D. E. Hedlund.
Designed to develop skills for, and understanding of, effective interpersonal communication and interaction. The course is largely experiential, utilizing audio and video recordings in laboratory sessions. Students should have access to a cassette recorder.

414 Counseling Psychology Spring. 4 credits. Limited to 30 students. Prerequisites: introductory psychology, social or personality psychology, and Education 413.
T R 10:10–12:05. D. E. Hedlund.
The processes of counseling are examined from the perspectives of behavioral psychology and humanistic psychology. Research on adult development, college-age and on, is reviewed, and typical adult counseling issues are examined. Implications are drawn for counseling strategy with an adult population, including psychological assessment, establishing therapeutic goals, intervention strategies, and evaluation of outcomes. Alternative models of service delivery such as outreach, consultation, and psychoeducation are emphasized.

420 (400) Field Experience Fall or spring. 1–4 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
Students may engage in planned, semiprofessional or professional practice in an educational enterprise.

Each student prepares a plan of action including rationale, purposes, and procedures and arranges with a faculty member to supervise and evaluate the field experience.

430 Special Problems in Agricultural Education Fall, spring, and summer. 1–3 credits. S-U grades optional.
Fall and summer: hours to be arranged. Spring: T 8. R. W. Tenney.
An opportunity to study individually selected problems in agricultural education.

432 Teaching Agriculture: Methods, Materials, Practice Fall. 9 credits. Prerequisite: Education 331 and concurrent registration in Education 430 and 434.
M T W R F 8–3. A. L. Berkey and staff.
Directed participation in teaching agriculture at the secondary school level. Program includes an intensive, four-week on-campus period where methods and materials of teaching agriculture are treated in detail, combined with a ten-week period in a student teaching center. Includes evaluation of area resources, instructional materials and facilities, development of curricula, directing work experience, planning instruction, and advising youth organizations.

434 Adult Education Programs in Agriculture Fall. 3 credits. Prerequisite: concurrent registration in Education 430 and 432.
Lec to be arranged. H. D. Sutphin.
Determining instructional needs, planning programs of instruction, teaching in groups, giving on-the-job instruction, and evaluating adult education programs in agriculture.

445 Curriculum Design Fall. 3 credits. Education 545 may be taken concurrently.
T R 10:10–11:30. G. J. Posner.
A general practical approach to course planning. Readings, group discussions, workshops, and individual conferences centering on each student's project. This project consists of designing a course in a subject area, for an age level and an institutional setting of the student's choosing.

446 Implementing Instruction Spring. 2 credits.
Lec-lab, W 1:25–4:25. V. N. Rockcastle.
A study of the elements of effective instruction in lecture, laboratory, seminar, field trip, and other modes of instruction. Practice in developing and presenting various modes of instruction, with critiques by the class.

472 Philosophy of Education Fall. 3 credits.
T 2:30–4:25. K. A. Strike.
A study of central issues in the philosophy of education. Questions of ethics, political philosophy, and the theory of knowledge are examined, and the implications for education assessed.

473 Contemporary Philosophy of Education Spring. 3 credits.
M W 11:15; disc, 1 hour to be arranged.
D. B. Gowin.
The topic is value concepts. Issues of value in education (values clarification, behavior modification, moral development) are treated philosophically by drawing on normative concepts of value (e.g., self-interest, utility, freedom, rights and duties, justice) from ethics and social philosophy. A theory of value for education is discussed.

477 Law and Educational Policy Spring. 3 credits. Offered alternate years.
T 2:30–4:30. K. A. Strike.
A study of recent federal court decisions concerning education. Emphasis on examining legal issues against a background of related educational theory and in terms of the consequences of legal decisions for the development and operation of educational institutions.

[481 (435) Educating for Community Action Spring. 3 credits. Not offered 1982–83.
T R 10:10–12:05. R. L. Bruce.
The design and execution of educational aspects of community-action programs. Deals with the identification and statement of educational goals, selection of teaching strategies, and evaluation of outcomes.]

497 Independent Study Fall or spring. 1–3 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
A student may, with approval of a faculty adviser, study a problem or topic not covered in a regular course or may undertake tutorial study of an independent nature in an area of educational interest.

498 Undergraduate Teaching Fall or spring. 1 or 2 credits; 4 credits maximum during undergraduate career. Limited to students with grade point averages of at least 2.7. S-U grades optional.
Designed to consolidate the student's knowledge. A participating student assists in teaching a course allied with the student's education and experience. The student is expected to meet regularly with a discussion or lab section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

499 Undergraduate Research Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with grade averages of at least 2.7.
Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

547 Improvement of College Teaching Fall, spring, or summer. 2 credits.
Staff.
Concepts of teaching, learning, curriculum, and governance are used to guide practical activities that enhance faculty competence. Recent studies of concept mapping and learning, structure of knowledge, science teaching, adult learning, and evaluation provide a conceptual basis for improving teaching. Videotape techniques will be used to provide a basis for constructive analysis of teaching performance.

567 Administration of Higher Education Summer. 3 credits. S-U grades optional.
M–R 10–12 and 2–4. Staff.
This intensive, three-week course focuses on areas of primary importance to those who want an overview of the theory and practice of higher education. Aspects covered in the course include planning, organizing, administering and evaluating. Also, individualized research papers will be expected.

590 Special Topics in Education Fall, spring, summer. 1–3 credits. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. Staff.
Study of topics in education not otherwise provided by a department course. Designed for both current administrators and teachers and those entering the profession.

[603 (544) Teaching Mathematics Spring. 3 credits. Not offered 1982–83.
T R 2:30–3:45. H. A. Geiselmann.
Intended to provide competence in presenting mathematics using various approaches—discovery, audiovisual aids, laboratory techniques, individualized instruction, use of games, puzzles; acquaintance with teaching resources; geometrical constructions; discussion of the slow learner. Each student selects a project and presents it to the class.]

606 Seminar in Science and Environmental Education Fall or spring. 1 credit.
T 7:30–9:30 p.m. V. N. Rockcastle, R. B. Fischer.
Coordinates various interest groups in science and environmental education. Discussions center around curriculum development, research and thesis writing, and current problems. Special emphasis for fall term: energy, its meaning, use, and conservation.

611 (511) Educational Psychology Fall. 3 credits. Prerequisite: introductory psychology. S-U grades optional.
M W F 1:25. R. E. Ripple.
A basic survey course for graduate students. Emphasis on psychological factors involved in human learning and the educational process. Set in a broad-based conceptual model of any behavioral setting for learning. Appropriate for those seeking an introduction to educational psychology or a refresher course in contemporary educational psychology.

612 (512) Standardized Tests: Use and Interpretation Fall. 3 credits.
R 3:35–5:15, 1 additional hour to be arranged.
Staff.
For teachers, counselors, or personnel majors who plan to work with standardized tests.

613 (513) A Theory of Education Fall. 3 credits. Prerequisite: Education 311 or 511, or permission of instructor.
T R 9:05. J. D. Novak.
Presents a coherent theory of education combining concepts from philosophy, psychology of learning, curriculum, and instruction. Classes include discussion of student-initiated questions. Students are assisted in applying theory to their own discipline.

614 (514) Group Processes in Education Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional.
T R 10:10–12:20. D. E. Hedlund.
Consideration of effective group membership and leadership with emphasis on the theory and practice of facilitating small-group processes. Included are the design and evaluation of structured group exercises for the classroom, the use of groups in counseling, and an examination of the consulting role as an educational strategy.

616 (515) Affective Education Spring. 3 credits. Prerequisite: permission of instructor.
M W 1:25–3:30. D. E. Hedlund.
This course examines the conceptual base and the methodology of teaching for objectives in the affective realm. The first part of the semester is devoted to the intrapersonal dynamics of individual development and the relationship of affective and cognitive learning. The second part focuses on the interactive nature of the teaching-learning transaction and the effective use of small-group dynamics in teaching. The capability to design teaching-learning experiences that incorporate affective objectives is a major goal. The course is largely experiential, providing participation in a variety of approaches to affective education.

620 (600) Internship in Education Fall or spring. 2–6 credits. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for supervising the work.
Staff.
An opportunity for practical experience in educational professions development.

630 Special Problems in Agricultural and Occupational Education Fall and spring; may also be offered in summer session. 1–3 credits. S-U grades optional.
Hours to be arranged. R. W. Tenney and staff.

The course provides an opportunity for graduate-level study of individually selected problems and issues in agricultural and occupational education. Designed for experienced teachers.

632 Teaching Agricultural and Occupational Education Spring. 3 credits. Prerequisite: an introductory course in teaching methods or permission of instructor.
M 2:30–5. A. L. Berkey.
The focus of the course is on the selection, use, and evaluation of methods and materials for teaching occupational subjects. Methods for both group and laboratory instruction are covered. Opportunity is provided through use of modules for students to develop teaching competencies based on their individual needs and interests. Development of self-evaluation skills is included. A class project on the selection or development of instructional materials is required.

633 Curriculum in Agricultural and Occupational Education Fall. 3 credits.
M 1:25–3:30; labs to be arranged. W. E. Drake.
Current situations affecting occupational education curricula are examined. Principles, objectives, and sources of information are developed for planning curricula. Strategies for developing occupational courses are examined. Consideration is given to planning, developing, and managing work experience programs. Participants have an opportunity to observe ongoing programs at the secondary and two-year-college levels and pursue individual interests in curriculum improvement.

643 (543) Structure of Knowledge and Curriculum Spring. 3 credits. Prerequisite: permission of instructor.
M W 12:20–2:10. D. B. Gowin.
A method for the critical analysis of knowledge and value claims embedded in primary sources is presented. Students use this method of analysis on materials chosen according to their own background or interest. Students develop their materials to the point where they could be used for instructional purposes. A special theory of curriculum developed by the instructor is presented.

644 (545) Curriculum Theory and Analysis Fall. 3 credits. Prerequisite: Education 311 or 511, concurrent registration in Education 511, or permission of instructor.
M W 10:10–11:30. G. J. Posner.
An examination of the basic elements involved in making curriculum decisions, and an analysis of current approaches to curriculum. Students learn to analyze a curriculum in the context of a conceptual framework. This course is the basic graduate course in curriculum.

650 (519) Methods of Educational Inquiry Fall. 1–3 credits.
T R 2:30–4 (see below for dates). J. Millman.
Techniques of empirical research are offered in three independent units: (a) survey of empirical approaches to social science inquiry, (b) design of educational research, and (c) methods of data collection. Course credit varies, depending upon the number of units the student elects. Units a, b, and c are covered during the first, second, and third thirds of the semester respectively.

651 Writing a Thesis Proposal Fall. 1 credit. S-U grades only.
T 4:10–5. J. Millman.
Procedures for developing and writing a master's or doctoral thesis proposal. Emphasis will be given to identifying a significant topic, conducting and describing a group mini-research study, recognizing weaknesses in illustrative proposals, and clear and concise writing. Students will be provided ample assistance in constructing a proposal on their own.

[654 (546) Evaluation for Program Management Spring. 1–3 credits. S-U grades optional.
M 2:30–5. R. L. Bruce. Not offered 1982–83.
The course will consist of three modules, each for one hour of credit:

1) *Evaluation as a Programming Function.* Fitting an evaluation to decision needs; program monitoring; evaluation and information systems. No prerequisite.
2) *Evaluation Models.* Comparative examination of various models and their implications for practice. No prerequisite.
3) *Practicum in Program Evaluation.* Directed practice in the design and conduct of a "live" evaluation. Prerequisite: module 1.]

659 Special Topics in Research Methods Spring. 1–3 credits. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. J. Millman.
Consideration of new techniques and current topics in educational research design, measurement, or evaluation of programs, products, and personnel. The course is divided into three independent modules. Students may elect one to three modules in any combination.

661 (561) Administration of Educational Organizations Fall. 3 credits.
W 3:35–6. E. J. Haller.
Perspectives on the administration of educational organizations. Consideration of classic and contemporary organization theories and their application to both public and higher education. Intended for students who are considering careers as educational administrators as well as for those who want to further their understanding of schools as organizations.

[662 (562) Ethical Issues in Educational Administration Spring. 3 credits. Offered alternate years. Not offered 1982–83; next offered 1983–84.
T 2:30–4:30. E. J. Haller, K. A. Strike.
This course deals with the identification and conceptualization of ethical problems likely to arise in administering an educational organization. Typical problems concern rights of parents, teachers, and students; equity and due process in hiring; retention and promotion; and race relations. The course integrates case studies with appropriate philosophical literature.]

[663 (563) Governance of Public Education Fall. 3 credits. Offered alternate years. Not offered 1982–83.
W 3:35–6. E. J. Haller.
Consideration of the structure of control in public education. Relationships among federal, state, and local agencies and the administrative roles in school districts. Considerable attention is directed to social and political analysis of the community.]

664 (564) Educational Finance Fall. 3 credits. S-U grades optional.
W 9:05–11:30. D. H. Monk.
Attention is focused on tasks and procedures involved in budgeting, allocation, control, accountability, and the measurement and reporting of benefits and productivity. An opportunity for individuals to focus on their own areas of interest, such as occupational education, the two-year college, the secondary school, or higher education.

665 (565) Administrative Decision Making Spring. 3 credits. S-U grades optional.
W 3:35–6. D. H. Monk.
An introduction to alternative theories of decision making and their relevance to the field of educational administration. Emphasis will be placed on the analysis of the linkages that exist among different levels of decision making within educational systems. Topics will include the impact of state and federal policy on educational organizations, collective bargaining, student decision making, and the dynamics of planned technological change.

[668 (569) Personnel Development: Issues in Higher Education Spring. 3 credits. Not offered 1982–83.
R 3:35–6. H. L. Wardeberg.
An examination of selected issues that affect the administration and development of academic and nonacademic personnel in continuing and higher education institutions.]

673 Seminar in Dewey's Philosophy of Education Fall. 3 credits. Prerequisite: work in philosophy and permission of instructor. S-U grades optional.
R 3–5. D. B. Gowin.
A detailed analysis of some selected major works of Dewey *(Democracy and Education, Experience and Education, Art as Experience).* One objective of the seminar is to help students learn how to read Dewey and to compare and apply his ideas about education to current problems and issues.

674 (574) History of American Education Fall. 3 credits.
M 3:35–5:15. Instructor to be announced.
An examination of American schools, colleges, and other educative agencies from colonial beginnings to the present. An attempt is made to view education in the context of the evolution of American norms and values.

675 (575) Educational Policy Development and Decision Making Fall. 3 credits. S-U grades optional.
R 3:35–5:30. E. J. Haller.
This course provides an introduction to the policy-making process in and around the educational institution. After a consideration of the nature of public policy, topics included are governmental responsiveness, power and influence in policy making, political parties and interest groups, and administration as policy making. The class is organized as a seminar. Each student prepares and presents a paper relevant to one of the topics considered.

[678 Planning Educational Systems Spring. 3 credits. S-U grades optional. Offered alternate years. Not offered 1982–83.
T R 12:20–1:50. D. H. Monk.
A seminar focused on a comparative analysis of educational planning as it is practiced in both industrialized and developing nations. Topics will include manpower planning, the social demand approach to educational planning, benefit-cost analysis, and incentive models of planning. Attention will be given to case studies that will be selected in accordance with students' interests. The political and economic implications of attempts to plan education will be emphasized.]

[679 Policy Issues in Higher Education Spring. 3 credits. S-U grades optional. Offered alternate years. Not offered 1982–83.
T R 12:20–1:50. D. H. Monk.
A seminar dealing with the planning, financing, and administration of higher educational organizations. Topics include a critical assessment of current approaches to macrolevel planning as well as the analysis of special problems associated with the financing and administration of particular types of colleges and universities.]

681 (624) Designing Extension and Continuing Education Programs Fall. 3 credits. Prerequisite: permission of instructor.
T 1:25–4. R. L. Bruce.
Designed to help students understand current theories, concepts, principles, and procedures relevant to the process of developing programs and curricula for the continuing education of adults. Emphasis is on such key areas as the nature and role of programming, situation analysis and needs identification, choosing among alternative courses of action, stating program objectives, and program organization.

682 (628) Community Education Development Fall. 3 credits. For students who have interest or experience in education or development programs where community is an important concern.
W 2:30–5. J. L. Compton.
An examination of the concept of community; changes in community life; the analysis of community; alternative strategies for community development; patterns of response to community by universities, colleges, schools, cooperative extension, and government service agencies; and such functional dimensions of community education programming as participatory decision making, paraprofessionals, volunteers, leadership development, council formation and function, interagency coordination, and change-agent roles.

683 (535) Continuing Education Programs Spring. 3 credits. Prerequisite: prior work experience preferred.
W 1:20–4. G. J. Broadwell.
An overview of selected theories, principles, and strategies applicable to management of decentralized, professionally staffed, nonformal educational organizations and change agencies. Content includes management functions, managerial leadership, management by objectives, and decision-making strategies. Particular attention is given to leadership of organizations with volunteer staff.

684 (634) Adult Education Programs: Organization and Direction Fall. 3 credits.
F 1:25–4:20. H. D. Sutphin.
Alternative procedural models for organizing and conducting adult occupational education courses are presented. Guidelines and procedures for implementing the models in secondary and postsecondary school settings are emphasized.

690 (601) Research Seminar Fall and spring. Noncredit.
M 4–5:30. J. P. Bail.
Presentation of current research in the field of education by graduate students and staff. Opportunities to discuss methodology, findings, and other aspects of research.

711 Seminar in Educational Psychology Fall. 3 credits. Prerequisite: permission of instructor before first meeting. S-U grades optional.
R 3:35–6. M. D. Glock.
The seminar has varied emphasis from year to year. See the instructor for current topic.

712 (611) Seminar in Educational Psychology and Curriculum Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years.
Hours to be arranged. R. E. Ripple.
Selected aspects of the relationship between curriculum and the psychology of education. Emphasis is on the psychology of human learning and implications for structuring learning experiences and curriculum development. Appropriate for graduate students in educational psychology, curriculum, and instruction, and others with interests in the relationship between psychology and curriculum.

715 (615) Seminar in Counseling Psychology Fall or spring. Variable credit. S-U grades only.
W 1:25–3:30. D. E. Hedlund.
Selected topics in counseling psychology to be announced.

718 (618) Adult Learning and Development Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years.
Hours to be arranged. R. E. Ripple, R. L. Bruce.
Deals with adult development and learning behavior from points of view of educational psychology, social psychology, and sociology. Inferences are drawn from theory and research to the practice of adult continuing education. Appropriate for graduate students in educational psychology, extension and continuing education, community service education, and others interested in adult learning and development.

730 Seminar in Agricultural and Occupational Education Spring. 2 credits. S-U grades optional.
R 2:30–4:25. H. D. Sutphin.
For master's degree candidates who have had teaching experience and doctoral candidates with majors or minors in agricultural and occupational education. Emphasis is on current problems and research and includes discussion of student research proposals.

735 (635) Teacher Preparation in Agriculture Fall. 3 credits. Prerequisite: teaching experience in agriculture.
W 1:25–3:20. A. L. Berkey.
For persons with teaching experience interested in the preparation of occupational teachers. Involvement in the Cornell program of teacher preparation in agriculture is expected.

736 (636) Occupational Education Program: Administration and Supervision Spring. 3 credits. Offered alternate years.
W 2–4:15; special sessions to be arranged.
J. P. Bail.
Practices and procedures of organizing, administering, and supervising programs of occupational education at the secondary and postsecondary level are stressed. The role of the director in providing leadership in improving instruction, designing programs, and using resources at federal, state, and local levels is considered.

739 (639) Evaluating Programs in Occupational Education Spring. 3 credits.
T 1:25–3:20; labs to be arranged. W. E. Drake.
This course examines objectives, criteria, and strategies for evaluating programs of occupational education in secondary and postsecondary schools. Evaluation models, case studies, and evaluation as a function of program planning are considered. Participants examine the roles of supervision in evaluation and have an opportunity to develop and apply evaluative instruments. Field trips and resource persons provide opportunities to observe actual evaluation problems and procedures.

745 (645) Seminar in Curriculum Theory and Research Spring. 3 credits. Prerequisite: Education 445–545 or permission of instructor.
W 9:05–11:30. G. J. Posner.
Theoretical issues in curriculum, and appropriate areas for curriculum research are discussed.

750 (619) Conceptual Problems in Educational Inquiry Fall. 3 credits. Prerequisite: experience or course work in research. S-U grades optional.
R 12:20–2:20. D. B. Gowin.
Techniques and procedures for the critical appraisal of research documents. Practice in such appraisal is required, with primary emphasis on conceptual structures rather than research techniques. Students may use their own research proposals or research products as material for analysis.

751 (716) Seminar in Educational Research and Evaluation Fall or spring. 3 credits. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. J. Millman.
An intensive study of the literature in a particular area of research methodology. Topics in recent years have included procedures and issues in educational evaluation, the interface of instruction and measurement, and the design of educational experiments. Current topic to be announced.

752 (602) Proseminar in Organization and Management of Sponsored Research Fall and spring. 2 credits each term. S-U grades only. Prerequisite: permission of instructor.
Hours to be arranged. J. A. Dunn.
Designed for doctoral students, advanced graduate students, and practitioners in the field who have responsibility for the promotion, management, or supervision of educational research, development, or evaluation projects. The seminar is devoted to an in-depth review of the history of educational research, patterns of federal support, the federal procurement process, proposal preparation, research management, and futures analysis. Successful and unsuccessful proposals are analyzed. Attention is given to alternative strategies for proposal development.

762 (669) Research in Educational Administration Spring. 3 credits. Prerequisite: one course in elementary statistics or permission of instructor. S-U grades only.
Hours to be arranged. E. J. Haller.
An analysis and critique of current research in educational administration. Discussion of research priorities and strategies in the conceptual area of educational governance. For graduate students interested in conduct of research on problems of educational governance. Students will carry out a small-scale empirical research project.

[771 Seminar in the Sociology of Education Fall. 3 credits. S-U grades optional. Not offered 1982–83.
Hours to be arranged. E. J. Haller.
Intensive study of a selected topic in the sociology of education, with consideration of its organizational and policy implications.]

772 Seminar in Philosophy of Education Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. K. A. Strike.
Topics to be announced.

[782 (627) Behavioral Change in International Rural Modernization Fall. 3 credits. For students who have interest or experience in international rural development or community development. Not offered 1982–83.
J. L. Compton.
An exploration of the social psychological aspects of socioeconomic development, focusing on the theoretical orientations of individual modernity, values-beliefs-motives, achievement motivation, entrepreneurship, innovativeness, expectancies, and self-efficacy, and the applied orientations of indigenous learning and knowledge systems, adoption behavior under conditions of risk and uncertainty, appropriate social-educational-biochemical technology, communication-diffusion of innovations, and development education.]

783 (629) Comparative Extension Education Systems Spring. 3 credits. Prerequisite: Education 627 or permission of instructor.
R 1:25–4:25. J. L. Compton.
Extension education in the developing nations is studied using, as an analytical frame of reference, a hypothetical model comprised of such components as community organization, community-based learning, indigenous facilitators and leaders, extension generalists and specialists, residential training, and research-training linkages. Case materials on alternative extension models and intercounty experiences provide an empirical base.

800 Master's-Level Thesis Research Fall or spring. Credit arranged. S-U grades optional. Each registration must be approved by a faculty member who will assume responsibility for guiding the work.
Staff.
Limited to students working on theses or other research and development projects.

900 Doctoral-Level Thesis Research Fall or spring. Credit to be arranged. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for guiding the work.
Staff.

Limited to students working on theses or other research and development projects.

Related Course in Another Department

Historical Roots of Modern Psychology (Psychology 490)

Entomology

M. J. Tauber, chairman; C. O. Berg, emeritus, W. L. Brown, Jr., R. I. Carruthers, E. W. Cupp, J. E. Dewey, G. C. Eickwort, P. P. Feeny, J. G. Franclemont, emeritus, G. G. Gyrisco, H. H. Hagedorn, W. T. Johnson, J. P. Kramer, R. A. Morse, A. A. Muka, L. L. Pechuman, emeritus, B. L. Peckarsky, D. Pimentel, E. M. Raffensperger, R. B. Root, D. A. Rutz, A. J. Sawyer, M. Semel, E. H. Smith, W. M. Tingey, Q. D. Wheeler, C. F. Wilkinson, R. G. Young

Courses by Subject

Apiculture: 260, 262, 264
Behavior: 662
Ecology: 370, 455, 457, 471, 664, 672
Introductory courses: 200, 212
Medical entomology and pathology: 452, 453, 454
Morphology: 322
Pest management: 241, 342, 440, 443, 640, 677
Physiology and toxicology: 483, 685, 687, 690
Systematics and acarology: 331, 332, 621, 631, 633, 634, 636, 674

200 Insects and Man Fall. 2 credits. S-U grades optional. Intended for students in all colleges.
Lecs, T R 11:15. E. M. Raffensperger.
A presentation of the insects, with attention to their roles in nature and in civilization. Biological, historical, social, economic, and cultural aspects are discussed.

212 Insect Biology Fall. 3 credits. Prerequisite: Biological Sciences 101–102 (may be taken concurrently) or equivalent.
Lecs, W F 11:15; lab, M T W or R 2–4:25.
G. C. Eickwort.
Introduces the science of entomology by focusing on basic principles of systematics, morphology, physiology, behavior, and ecology of insects. The laboratory in early fall includes field trips to collect and study insects in the natural environment. A small collection stressing ecological categories is required.

241 Applied Entomology Spring. 3 credits. Prerequisite: Biological Sciences 101–102 or equivalent.
Lecs, T R 10:10; lab, M T W R or F 2–4:25.
E. M. Raffensperger.
A compendium of the insects associated with crops and farm animals. Discussions of insect pest management requirements on farm and in garden, along with descriptions of control methods, materials, and equipment.

260 Introductory Beekeeping Fall. 2 credits.
Lecs, T R 11:15, R. A. Morse.
Introduces the fundamentals of beekeeping, including the life history, instincts, and general behavior of honey bees. Attention is given to the biology of the honey bee. Some lectures are devoted to pollination of agricultural crops and the production of honey and beeswax.

262 The Biology of the Honey Bee Fall. 1 credit. Limited to 10 students. Prerequisite: permission of instructor.
Labs, afternoons or weekends to be arranged; course will meet in September and October only.
R. A. Morse.
A series of laboratories in which students perform some of the classical experiments on honey bee behavior. Various techniques of bee research are introduced.

264 Practical Beekeeping Fall. 1 credit. Limited to 20 students. Prerequisite: Entomology 260 (may be taken concurrently).
Lab, W or R 2–4:25. R. A. Morse.
Fourteen laboratory sessions to acquaint students with practical methods of colony management. Laboratories involve actual work with honey bee colonies and equipment. Additional laboratories cover management of bees for apple pollination, honey harvesting and processing, and disease identification and control. Sessions will meet on a Saturday, and another during the evening.

[322 Insect Morphology Fall. 5 credits. Prerequisite: Entomology 212 or 241. Offered alternate years. Not offered 1982–83; next offered 1983–84.
Lecs, M W F 10:10; labs, M F or T R 1:25–4:25.
G. C. Eickwort.
An introduction to the external and internal anatomy of insects, with emphasis on the comparative and functional aspects. The laboratory is devoted largely to dissection.]

331 Introductory Insect Systematics Spring. 4 credits. Prerequisite: Entomology 212. Recommended: concurrent enrollment in Entomology 332.
Lecs, T R 10:10; labs, T R 1:25–4:25; Saturday field trips. Q. D. Wheeler.
An introduction to the classification, evolutionary history, and distribution of the insects. Laboratory practice in the identification of orders, families, and representative genera of insects; methods of collection, preservation, and study. Lectures on theory and practice of insect systematics and major features of insect evolution. Insect collections are required.

332 Systematics Discussion Group Spring. 1 credit. Prerequisite: concurrent enrollment in Entomology 331 or permission of instructor. S-U grades only.
Disc, hours to be arranged. Q. D. Wheeler.
Readings and discussion on topics in systematics coordinated with the lecture series in Entomology 331.

341 Arthropods of World Importance Fall. 2 credits. Prerequisite: Entomology 212 or 241 or permission of instructor.
Lecs, T R 9:05. E. H. Smith.
The impact of arthropods on human affairs is considered. Special attention is given to problems of insect control in developing countries. How cultural, social, and economic factors influence the selection of control practices is emphasized.

342 Special Topics in Economic Entomology
Hours to be arranged. Staff.
Topics to be announced.

370 Pesticides in the Environment Fall. 2 credits. Prerequisites: Biological Sciences 101–102 or equivalent.
Lecs, T R 9:05. D. M. Soderlund.
A survey of the different types of pesticides, their uses, their distribution in the environment, and their effects on various components of the environment. For students whose main emphasis is not in pesticide usage.

440 Insect Pest Management Spring. 4 credits. Prerequisites: Entomology 212 or 241, and Entomology 455 or Biological Sciences 360, or permission of instructor.
Lecs, M W F 9:05; lab, M 1:25–4. A. J. Sawyer.
A lecture and laboratory introduction to principles and techniques of insect pest management as these relate to the diverse problems in contemporary economic entomology.

441 Seminar in Insect Pest Management Spring. 1 credit. Limited to 10 students. Prerequisite: Entomology 241 or 440 or permission of instructor. S-U grades only.
Hours to be arranged. A. M. Shelton, A. J. Sawyer.
Discussion of topics in pest management with an emphasis on insect pest management. Group discussion will focus on critical readings of the literature. Topics include the philosophy and foundations of pest management and an examination of its principal tools.

443 Pathology and Entomology of Trees and Shrubs (also Plant Pathology 443)
See Plant Pathology 443 for course description.

[452 Medical Entomology Fall. 3 credits. Prerequisites: either Entomology 212 and Veterinary Medicine 330 or permission of instructor. Offered alternate years. Not offered 1982–83; next offered 1983–84.
Lecs, T R 10:10; lab, R 1:25–4:25. E. W. Cupp.
A survey of arthropods of public health and veterinary importance, with emphasis on transmission dynamics of pathogens, bionomics of vector populations, and current control concepts. Morphology and taxonomy of selected groups are examined in the laboratory, with additional exercises in vector-pathogen relationships and epidemiological techniques.]

453 Insect Pathology Spring. 4 credits. Prerequisites: Entomology 212 or 241 or permission of instructor. Recommended: a course in Microbiology. Offered alternate years.
Lecs, M W 10:10; lab, R 1:25–4:25. J. P. Kramer.
A survey of the diseases of insects caused by viruses, bacteria, fungi, and protozoans, and a consideration of the role of microbial diseases in natural and applied insect control. Laboratory investigations center around living insect—pathogen associations and the consequences of these associations for both insect and microbe.

[454 Insect Pathology Seminar Spring. 1 credit. Prerequisites: Entomology 453. S-U grades only. Offered alternate years. Not offered 1982–83; next offered 1983–84.
Hours to be arranged. J. P. Kramer.
Presentations, discussions, and analyses of current topics by the participants. Focus centers on microbial diseases of insects.]

[455 Insect Ecology, Lectures (also Biological Sciences 455) Fall. 2 credits. Prerequisites: Biological Sciences 360 and Entomology 212, or their equivalents. Recommended: concurrent enrollment in Biological Sciences 457. Offered alternate years. Not offered 1982–83; next offered 1983–84.
Lecs, W F 11:15. R. B. Root.
Ecological and evolutionary principles are integrated by thorough examination of outstanding investigations. Topics discussed include the factors responsible for the great diversity of insects, adaptive syndromes associated with climate, natural history of arthropod guilds, impact of insects on terrestrial vegetation, population regulation, and the contrast between natural and managed ecosystems.]

[457 Insect Ecology, Laboratory (also Biological Sciences 457) Fall. 2 credits. Limited to 16 students. Prerequisite: concurrent enrollment in Biological Sciences 455. Offered alternate years. Not offered 1982–83; next offered 1983–84.
Lab, W 1:25–4:25; F or S field trips to be arranged during the field season. R. B. Root.
Field exercises focus on insect natural history and methods of sampling populations. Laboratories devoted to rearing insects, estimating life-table parameters, and analyzing communities.]

471 Ecology and Systematics of Freshwater Invertebrates Spring. 4 credits. Prerequisite: Entomology 212. Recommmended: Biological Sciences 360–462–464.
Lecs, T R 9:05; labs, M W or T R 1:25–4:25. One evening prelim. B. L. Peckarsky.
The lecture explores the life histories, behavior, feeding ecology, and limitations to distributions of macroscopic freshwater invertebrates with an emphasis on insects. The laboratory involves field

collections and laboratory identification of invertebrates, and stresses the use of keys. Students may elect to conduct ecological field projects or to study the systematics of freshwater invertebrates in more depth.

483 Insect Physiology Spring. 4 credits. Prerequisite: Entomology 212.
Lecs, M W F 11:15; lab, W or F 1:25.
H. H. Hagedorn.
An introduction to the often unique ways that insects have met their basic needs. Each organ system is examined with emphasis on basic principles and specific examples. The student will also be introduced to some common methods used in physiological research and to the critical reading of scientific literature.

497 Special Topics for Undergraduates Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work.
Staff.

499 Undergraduate Research Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work.
Staff.

[621 Acarology Fall. 4 credits. Prerequisites: Entomology 212 and permission of instructor. Offered alternate years. Not offered 1982–83; next offered 1983–84.
Lecs, M F 10:10; labs, M F 1:25–4:25.
G. C. Eickwort.
An introduction to the taxonomy, morphology, and bionomics of mites and ticks, with emphasis on taxa of economic importance. A collection is required.]

[631 Systematics of the Coleoptera Fall. 4 credits. Prerequisite: Entomology 331. Offered alternate years. Not offered 1982–83; next offered 1983–84.
Lecs, M W 12:20; labs, M W 1:25–4:25. Saturday field trips. Q. D. Wheeler.
A comprehensive review of the comparative morphology, phylogenetic relationships, classification, natural history, and distribution of the Coleoptera, including adult and immature stages. Laboratory practice in identification and methods for collection and study of beetles. A collection is required.]

633 Systematics of the Diptera and Hymenoptera Spring. 3 credits. Prerequisite: Entomology 331. Offered alternate years.
Lecs, W 10:10; labs, W F 1:25–4:25. W. L. Brown.
Lectures on the classification, evolution, and bionomics of the Diptera and Hymenoptera. Laboratory studies on the literature, characters, and classification of representative genera and species of these orders, based on adult and immature stages.

634 Special Topics in Systematic Entomology Fall or spring; taught on demand. 2–4 credits. Prerequisite: permission of instructor.
Hours to be arranged. Staff.
Lectures on the classification, evolution, and bionomics of selected taxa, with accompanying laboratory studies on identification and comparative morphology. Collections sometimes required.

636 Seminar in Systematic Entomology Fall or spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. Staff.
Discussion of current topics in systematic entomology. Topics to be announced, including current theoretical issues in insect classification, evolution, and biogeography.

640 Pest Management Systems Fall. 3 credits. Prerequisites: Entomology 440 or Plant Pathology 504, and a course in calculus. Recommended: an introductory course in computer science. S-U grades optional. Offered alternate years.
Lecs, M W F 9:05; disc, W 2:30–4:25. A. J. Sawyer.
Quantitative aspects of the development of pest and agricultural resource management systems. A major portion of the course deals with predictive simulation models and quantitative research. Other topics include philosophy, systems analysis, management and design, and communications and monitoring systems.

[662 Insect Behavior Seminar Spring. 2 credits. Prerequisites: permission of instructors and either Entomology 212 and Biological Sciences 321 or equivalents. S-U grades optional. Offered alternate years. Not offered 1982–83; next offered 1983–84.
Hours to be arranged. G. C. Eickwort, M. J. Tauber.]

664 Seminar in Coevolution between Insects and Plants Spring. 2 credits. Limited to 15 students. Prerequisites: entomology, ecology, evolution, organic chemistry, and written permission of instructor. S-U grades optional. Offered alternate years.
One evening a week, to be arranged. P. P. Feeny.
For graduate students and seniors. Presentations and discussions by students on the evolution of patterns of interaction between plants and insects, emphasizing critical evaluation of concepts and evidence.

672 Seminar in Aquatic Ecology Spring. 1 credit. Prerequisites: permission of instructor and either Entomology 471 or Biological Sciences 462, 464. Offered alternate years.
Hours to be arranged. B. L. Peckarsky.
Discussion and analysis of current topics in the ecology of streams and lakes, including synthesis of key papers in the literature. Reports on personal research or ideas by students are encouraged.

674 Principles of Systematics (also Biological Sciences 674) Spring. 4 credits. Prerequisite: Entomology 331 or introductory systematics course in another field of biological sciences.
Lecs, M W 1:25; labs, M W 2–4:25; disc, hours to be arranged. Staff (Q. D. Wheeler, coordinator).
An introduction to modern theory and methods of systematic biology. Lectures on theoretical systematics, including species concepts, classification, phylogenetics, and biogeography. Laboratories include modern methods of finding characters (such as comparative morphology, karyology, electrophoresis, ontogenetic sequencing) and various methods of analysis of data (e.g., cladistic hand and computer methods, numerical methods). Part of laboratory grade is based on a final paper.

677 Biological Control Fall. 3 credits. Prerequisites: Entomology 212, Biological Sciences 360, and permission of instructor. Offered alternate years.
Lecs, T R 9:05; lab, T 2–4:25. M. J. Tauber.
Theory and method of biological control of arthropod pests and weeds. Lab includes studies with living parasites and predators.

685 Seminar in Insect Physiology Spring. 1 credit. Prerequisite: permission of instructor.
Hours to be arranged. H. H. Hagedorn.

690 Insect Toxicology and Insecticidal Chemistry Spring. 4 credits. Prerequisites: general chemistry and organic chemistry. Undergraduate students by permission of instructor. Offered alternate years.
Lecs, M W F 9:05; lab, day to be arranged, 1:25–4:25. C. F. Wilkinson.
The chemistry of insecticides and their metabolism and mode of action in insects and mammals.

707 Special Topics for Graduate Students Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Not for thesis research.
Staff.

708 Graduate Research Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Not for thesis research.
Staff.

709 Teaching Entomology Credit to be arranged.
Staff.
Teaching entomology or for extension training.

800 Master's-Level Thesis Research Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
Staff.

900 Doctoral-Level Thesis Research Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
Staff.

Jugatae Seminar Fall and spring.
M 4–5.
A seminar conducted by Jugatae, the entomology club of Cornell University, to discuss topics of interest to its members and guests.

Floriculture and Ornamental Horticulture

C. F. Gortzig, chairman; M. I. Adleman, N. L. Bassuk, A. Bing, J. W. Boodley, E. J. Carter, A. M. Elliot, C. C. Fischer, R. T. Fox, G. L. Good, T. H. Johnson, R. J. Lambert, R. W. Langhans, A. S. Lieberman, L. J. Mirin, R. G. Mower, K. W. Mudge, F. B. Negm, A. M. Petrovic, E. F. Schaufler, J. G. Seeley, R. T. Trancik, P. J. Trowbridge

Courses by Subject

Commercial floriculture crop production: 424, 425.
Freehand drawing and illustration: see page 55.
Horticultural physiology: 401, 402, 601
Introductory courses: 100, 105
Landscape architecture (professionally accredited program): see pages 56–57.
Landscape horticulture: Landscape Architecture 205, 220, 224, 240, 310, 311, 521, 522
Nursery management: 421
Plant materials: 213, 312, 313, 322, 342, 450
Retail floriculture: 105, 325
Turfgrass management: 314, 318

100 Introductory Floriculture and Ornamental Horticulture Fall. 3 credits. Principally for freshmen. S-U grades optional for students not specializing in floriculture and ornamental horticulture.
Lecs, M W 8; lab, T or W 2–4:25. J. W. Boodley.
An introduction to basic plant physiology and plant processes, control of the plant environment, and the floriculture and ornamental horticulture industry and opportunities. A required one-day field trip is made to nearby commercial enterprises.

105 Floral Design Fall. 2 credits. Each lab limited to 22 students. Prerequisite: permission of instructor; preference given to plant science majors, then to students in education, design, and journalism studies. Students whose careers will involve using this horticultural expertise should apply. There is a $35 charge to purchase instructional plant materials that the student will keep. Enrolled students who do not attend the first class and fail to notify the secretary in Plant Science 20 of their absence will automatically be dropped from the course.
Lec-lab, T W or R 1:25–4:25. C. C. Fischer.
A study of the established floral design techniques of this country, presenting the principles and the mechanics of the art to prepare the student to design

for varying themes and occasions. Other aspects include selection, preparation, and factors affecting keeping quality of plant materials, emphasizing the economical use of all supplies.

213 Woody Plant Materials Spring. 4 credits.
Lecs, T R 9:05; lab, T 2–4:25 and W or F 2–4:25. R. G. Mower.
A study of the trees, shrubs, and vines used in landscape plantings. Emphasis is on winter identification and their values for use as landscape material.

312 Garden and Interior Plants I Fall. 3 credits.
Lecs, T R 10:10; lab, T 2–4:25. R. G. Mower.
A study of ornamental plants used in garden and interior situations. The first seven weeks cover primarily herbaceous annuals and perennials, with the lab devoted to various practical gardening activities. The remainder of the semester covers the major kinds of foliage and flowering plants used in the home and other interior landscape situations. Emphasis is on identification, use, and general cultural requirements.

313 Woody Plant Materials for Landscape Use Fall. 3 credits. Limited to 30 students. Primarily for landscape architecture majors.
Lec, M W 9:05; lab, W 2–4:25. R. G. Mower.
A study of the trees, shrubs, vines, and ground covers used in landscape plantings in the northeastern United States. Emphasis is on leaf identification and on characteristics that determine their usefulness as landscape subjects. Opportunity for independent study is provided.

314 Turfgrass Management Fall. 3 credits. Prerequisites: Agronomy 200. Biological Sciences 242 recommended or permission of instructor.
Lecs, M F 12:20; lab, F 1:25–4:25. Required, 1 Monday field trip. A. M. Petrovic.
The scientific principles, practices, and materials for the construction and maintenance of lawn, sports, and utility turfgrass areas. Environmental effects on growth are also studied.

318 Advanced Turfgrass Management Fall. 2 credits. Prerequisites: Floriculture 314 or equivalent, and permission of instructor.
Hours to be arranged. A. M. Petrovic.
A continuation of Floriculture 314, with emphasis on applying scientific principles to management of golf courses, athletic fields, parks, industrial grounds, and sod production.

322 Garden and Interior Plants II Spring. 3 credits. Prerequisite: Floriculture 312 or permission of instructor.
Lecs, M W 11:15; lab, M 2–4:25 (two sections to be arranged). R. G. Mower.
A continuation of Floriculture 312. The first seven weeks are devoted to a further study of interior plants, with emphasis on specialized groups of interior plants such as orchids, cacti and succulents, gesneriads, ferns, palms, and bromeliads. The second seven weeks are devoted to outdoor herbaceous plants such as tulips, daffodils, crocus, iris, as well as other spring-blooming bulbs and perennial plants. Outdoor laboratories emphasize practical gardening activities appropriate to the spring season.

325 Flower-Store Management Fall. 3 credits. Prerequisites: Floriculture 105 and permission of instructor. Lab materials charge, $35. Cost for field trips, $15 plus room and meals.
Lecs, W F 11:15–12:20; lab, F 1:25–4:25. R. T. Fox.
Lectures devoted to flower-shop management, business methods, merchandising, and marketing of floricultural commodities. Laboratories include the application of subject matter and the principles of commercial floral arrangement and design. Required field trips made to flower shows and to wholesale and retail florist establishments.

342 Taxonomy of Cultivated Plants (also Biological Sciences 342) Spring. 4 credits.
Lecs, M W 10:10; labs, M W 2–4:25. J. W. Ingram, Jr.
A study of ferns and seed plants, their relationships, and their classification into families and genera, emphasizing cultivated plants. Emphasis is on gaining proficiency in identifying and distinguishing families and to preparing and using analytical keys; attention is also given to the economic importance of taxa, to the basic taxonomic literature, and to the elements of nomenclature.

401 Principles of Plant Propagation Fall. 3 credits. Prerequisite: Biological Sciences 242 or 341 or permission of instructor.
Lecs, T R 8; lab, R 1:25–4:25 (except field trips lasting until 6:30 p.m.). Evening prelims. K. W. Mudge.
Physiological, environmental, and anatomical factors involved in the propagation of plants by seed germination, rooting of cuttings, layering, grafting, budding, bulbs, tissue culture, et cetera. Examples include horticultural, agronomic, and forestry crops.

402 Physiology of Horticultural Plants Spring. 4 credits. Prerequisite: Biological Sciences 242 or 342 or permission of instructor.
Lec, M W F 8; lab to be arranged. F. B. Negm.
A study of the physiology of growth and development of horticultural plants in response to their environment.

421 Principles of Nursery Crop Production Fall. 4 credits. Prerequisite: Floriculture 401.
Lecs, M W F 9:05; lab, M 12:20–2:15, 2:30–4:25; field trips are included in lab sessions. G. L. Good.
Problems of commercial propagation and growth of nursery plants to marketable stage, including the postharvest handling of nursery stock. Some consideration is given to the planting and culture of landscape plants.

424 Principles of Florist Crop Production Spring. 4 credits. Limited to 40 students. Preference given to juniors. Prerequisites: Floriculture 401 and Biological Sciences 242, 342 (may be taken concurrently), or equivalent; or permission of instructor. Cost for field trips, $20 plus meals.
Lec, M W F 9:05; lab, R 2–4:25. J. G. Seeley.
Commercial production of florist crops. Emphasis on principles of culture of ornamental plants as influenced by greenhouse environment. Field trips are made to commercial greenhouses.

425 Greenhouse Production Management Spring. 4 credits. Primarily for seniors. Prerequisite: an elementary course in horticulture or equivalent. Cost for field trips, $100.
Lecs, T R 10:10–12:05. Two field trips are taken. R. W. Langhans.
Intended to provide the latest information on efficient operation and administration of a commercial greenhouse, outside the sphere of production methods for specific crops. Consideration is given to the industry, centers of production, competition, location, types of structures, heating, ventilation, cooling, fertilizing, and watering systems, and business analysis and management.

450 Special Topics on Ornamental Plants Fall or spring. Credit to be arranged. Primarily for upperclass floriculture and ornamental horticulture majors. Prerequisites: Floriculture 213, 312, 313, or the equivalent, and permission of instructor.
Hours to be arranged. R. G. Mower.
Topical subjects in plant materials. Independent and group study of important groups of woody and herbaceous plant materials not considered in other courses. The topic is given in the supplementary announcement.

497 Special Problems in Floriculture and Ornamental Horticulture 1 or more credits. S-U grades optional. Prerequisite: students must satisfy the staff member under whom the work is to be taken that their background warrants their choice of problems. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
C. F. Gortzig and staff.
Study of problems under investigation by the department or of special interest to the student.

600 Seminar Fall or spring. For department staff and graduate students. S-U grades only.
R 12:10.

601 Current Topics in Floricultural and Ornamental Horticultural Physiology Spring. Variable credit. Prerequisite: permission of instructor.
Hours to be arranged. F. B. Negm.
Discussions of modern concepts, research, and commercial problems as reflected in current horticultural literature.

Freehand Drawing and Illustration

109 Nature Drawing Fall. 3 credits. Limited to 25 students. S-U grades optional.
M W F 10–12. R. J. Lambert.
A beginning course with emphasis on the drawing of natural forms: plants, animals, and landscapes. Of particular interest to students in floriculture and ornamental horticulture, landscape architecture, biological sciences, nature education, etc. Outside field notebook assignments.

111 Freehand Drawing Fall or spring. 3 credits. Each section limited to 25 students. S-U grades optional. Credit may not be received for both Floriculture 109 and 111.
Fall: lec, R 10:10; studio, T 9:05–11, R 1:25–4. Spring: permission of instructor required (lec and all studio hours must be scheduled). Lec T or W 10:10, plus 5 additional studio hours to be scheduled in 2- or 3-hour blocks during M T W R F 9:05–12:20 and T 1:25–4. A. Elliot.
Developing accuracy of observation and a personal graphic vocabulary. Freehand perspective and its uses in establishing design and spatial relationships, practice in figure and landscape drawing, form vs. value drawing. Outside sketchbook assignments.

210 Architectural Sketching in Watercolor Summer. 3 credits.
M–F 11–12:15. R. J. Lambert.
Practice in outdoor architectural sketching primarily in watercolor, but including pen and ink, pencil, and colored pencil. Studio will develop working sketches into complete renderings. Principles of perspective are taught and applied. For any student who wishes to develop skill in handling watercolor. Outside-of-class sketchbook work required.

211 Freehand Drawing and Illustration Fall. 2 credits. Prerequisite: Floriculture 111 or equivalent. S-U grades optional.
6 studio hours scheduled in two- or three-hour units between 9:05 and 12:05 M T W R F. R. J. Lambert.
Progression to the organization of complete illustrations. Subject matter largely from sketchbooks, still life, and imagination. Composition, perspective, and ways of rendering in different media are considered.

214 Watercolor Spring. 2 credits. Prerequisite: Floriculture 111 or equivalent. S-U grades optional.
6 studio hours scheduled in two- or three-hour units between 9:05 and 12:05 M T W R F. R. J. Lambert.
A survey of watercolor techniques. Subject matter largely still life, sketchbook, and on-the-spot outdoor painting.

316 Advanced Drawing Fall or spring. 2 credits. Prerequisite: Floriculture 211 or permission of instructor. S-U grades optional.
6 hours to be arranged. A. Elliot or R. J. Lambert.

For students who want to attain proficiency in a particular type of illustration or technique.

417 Scientific Illustration Fall. 2 credits. Prerequisite: Floriculture 211 or 316 or equivalent. S-U grades optional for graduate students only.
6 studio hours scheduled between 9:05 and 12:05 M W F. A. Elliot.
A survey of methods of illustration. Training in techniques of accurate representation in media suitable for reproduction processes, including pen and ink, scratchboard, wash, and mixed media.

Landscape Architecture

201 Design I: Basic Landscape Architectural Design Fall. 5 credits. Limited to landscape architecture majors. Estimated cost of drafting equipment (to be used throughout the 6-studio sequence) and supplies, $200. Basic expenses for field trip, about $175.
Lec, M 12:20; studio, M W F 1:25–4:25. Required 5-day field trip.
An introduction to landscape architectural design including design process, site inventory and analysis, basic design principles, and graphic communication. This is the first course in a sequence of six studio courses required for specialization in landscape architecture.

202 Design II: Basic Landscape Architectural Design Spring. 5 credits. Prerequisite: Landscape Architecture 201. Cost of supplies, about $100.
Lec, F 9:05; studio M W F 10:10–12:35.
Project planning with emphasis on site-design principles and the development of design and graphic skills. Projects deal with the organization of outdoor space and the siting of structures as well as the interrelationships of vehicular and pedestrian circulation, parking, open space, earth form, and vegetation.

205 Graphic Communication Fall. 3 credits. Prerequisite: concurrent enrollment in Landscape Architecture 201 or 501 or permission of instructor.
T R 9:05–11.
Principles of graphic presentation, including the use of media and rendering techniques applicable to presentation drawings for landscape architecture projects. Plan graphics, orthographic projections, isometric drawing, one- and two-point perspective as well as sections, elevations, and lettering will be introduced.

220 Principles of Landscape Architecture Fall. 2 credits.
Lecs, M W 9:05.
Basic principles involved in observation, analysis, and design methods as they relate to the outdoor environment. Readings and case studies deal with the application of these principles to all scales of land planning and design and include environmental systems, design theory, and American landscape history as applied to the contemporary practice of landscape architecture.

224 Plants and Design Spring. 3 credits. Limited to 30 students. Basic expenses for field trip, about $55.
Lecs, M W F 1:25. Required 2-day field trip.
M. I. Adleman.
Planting design principles; functional uses of plants in the landscape; ecological, horticultural, and maintenance determinants affecting the selection and use of plant materials; planting considerations in highly dependent landscapes including urban landscape, interior plantscape, and roofscape; plans, specifications, and procedures involved in planting implementation.

240 Landscape Design Spring. 3 credits. Limited to 15 students; priority given to landscape horticulture majors. Prerequisite: Landscape Architecture 205 and permission of instructor.
Lec, M 12:20; studio, M W 1:25–4:25.
Fundamentals of landscape design applied to residential and other small-scale site-planning projects. Work in the studio introduces design process, site-design principles, construction materials, planting design and graphics.

301 Design III: Intermediate Landscape Architectural Design Fall. 5 credits. Prerequisite: Landscape Architecture 202. Cost of supplies about $100. Basic expenses for field trip, about $175.
Lec, F 9:05; studio M W F 10:10–12:35. Required 5-day field trip.
Application of town-planning and urban-design techniques to specific field problems. Timely urban issues are investigated, including physical design considerations as well as the complex socioeconomic implications of urban design. Site-development problems at several scales and land-use intensities are examined.

302 Design IV: Intermediate Landscape Architectural Design Spring. 5 credits. Prerequisite: Landscape Architecture 301. Cost of supplies, about $100.
Lec, F 12:20; studio M W F 1:25–4:25.
Application of principles of composition, relationships to historic precedent, and use of materials in professional project design synthesis.

310 Site Construction I Spring. 4 credits. Prerequisite: permission of instructor.
Lecs, M W 9:05; studio, T R 9:05–11.
P. J. Trowbridge.
Lectures, exercises, and projects dealing with land-form design and the preparation of grading plans, calculation of earthwork, and layout of circulation systems, parking, and site utility systems. Required technical material is presented in modules with interim testing for competency in the subject areas.

311 Site Construction II Fall. 4 credits. Prerequisite: permission of instructor.
Lecs, T R 1:25; studio, T R 2:30–4:25.
T. H. Johnson.
Construction materials and methods used by landscape architects in project implementation. Course includes student involvement in demonstration construction, lectures, field trips, studio work on details and models, and construction documentation for a selected design project.

400 Thesis-Project Seminar Fall. 1 credit. Prerequisite: concurrent registration in Landscape Architecture 401.
Sem, W 12:20.
Seminar and preparation of program and base material for senior thesis projects in landscape architecture. Each student is required to select a project, develop a program, collect necessary data and base material, and make a presentation to the class for discussion. Landscape architecture majors must develop an approved senior thesis-project manual as a prerequisite for Landscape Architecture 402.

401 Design V: Advanced Landscape Architectural Design Fall. 5 credits. Prerequisite: Landscape Architecture 302. Cost of supplies, about $100. Basic expenses for field trip, about $175.
Lec, M 12:20; studio, M W F 1:25–4:25. Required 5-day field trip.
Application and testing of site planning, planting design, and site construction knowledge and skills. Projects involve design carried to advanced stages of layout, grading, planting, and detailing. Testing includes sketch problems as well as the design and construction sections of the CLARB Uniform National Examination.

402 Design VI: Senior Thesis Project Spring. 5 credits. Prerequisites: Landscape Architecture 400 and Landscape Architecture 401. Cost of supplies and reproductions, about $150.
Lec, F 9:05; studio, M W F 10:10–12:35.
Inventory, analysis, and design methods applied to approved senior thesis-project program developed in Landscape Architecture 400. An evaluation of minimum competence in landscape architecture.

421 Professional Practice Seminar Fall. 2 credits. Prerequisite: Landscape Architecture 302 or 602.
E. J. Carter.
Lectures and discussions dealing with professional landscape architectural practice in public, private, and academic career tracks. The course will also include field trips to representative professional offices and lectures by practitioners.

432 Introduction to Parks and Recreation Spring. 2 credits.
E. J. Carter.
Park development process and the relationship of park and recreation facilities to urban, suburban, and rural recreation needs; physical and fiscal resources; environmental planning issues; overall municipal development efforts; and the planning and design professions. Lectures, discussions, readings, and short papers.

435 Urban Environmental Planning Fall. 2 credits.
E. J. Carter.
Theories, principles, and practice of urban environmental planning dealt with in terms of (1) the planning context, (2) environment and ecology, (3) urban form, (4) urban conservation. Readings, discussions, student papers, and case study presentations.

436 Urban Environment Workshop Spring. 2 credits. Prerequisites: Landscape Architecture 435, one or more landscape architecture design studios, and permission of instructor.
Application of the theories, principles, and practice of urban environmental planning to problem solving in actual site situations. Projects emphasize planning process, analysis, programming, and design strategy.

497 Independent Study in Landscape Architecture Fall or spring. 1–5 credits; may be repeated for credit. S-U grades optional.
Staff.
Work on special topics by individuals or small groups.

501 Graduate Landscape Architectural Design I Fall. 5 credits. Limited to graduate students in landscape architecture. Estimated cost of drafting equipment (to be used throughout the studio sequence) and supplies, $200. Basic expenses for field trip, about $175.
Lec, M 12:20; studio, M W F 1:25–4:25.
Basic landscape architectural design introducing design process, site inventory and analysis, design principles, and graphics. This is the first course in a sequence of five design studio courses required for students in the graduate first-professional-degree curriculum in landscape architecture prior to development of a master's thesis.

502 Graduate Landscape Architectural Design II Spring. 5 credits. Prerequisite: Landscape Architecture 501. Cost of supplies, about $100.
Lec, F 9:05; studio, M W F 10:10–12:35.
Principles and process involved in site design relating to the organization of outdoor space and the interrelationships involved in the siting and design of buildings, vehicular and pedestrian circulation, parking, open space, vegetation, and topography.

***520 Contemporary Issues in Landscape Architecture** Fall. 2 credits.

***521 History of Landscape Architecture I** Fall. 3 credits.

*Offered through the College of Architecture, Art, and Planning.

***522 History of Landscape Architecture II**
Spring. 3 credits.
L. Mirin.

***530 Urban Landscape Planning and Design**
Spring. 3 credits.
L. Mirin.

531 Regional Landscape Planning I Fall.
3 credits. Prerequisite: permission of instructor.
Lecs, M W F 10:10. A. S. Lieberman.
Regional landscape planning strategies and methods that have been developed and employed in North America, Europe, Australia, and the Middle East. Presented through a series of lectures, readings, class discussions, exercises, and review of case studies. This course is intended for graduate students in landscape architecture, architecture, city and regional planning, ecology, international studies, international agriculture, and natural resources.

532 Regional Landscape Planning II Spring.
3 credits. Prerequisite; permission of instructor.
Lecs, M W F 10:10. A. S. Lieberman.
Vegetation analysis techniques and methods applied to comprehensive land-use planning and consideration of the environmental uses of plants in regional landscape planning. Landscape functions of vegetation at the regional scale are addressed through review of case studies in North America, Europe, the Middle East, and Australia.

601 Graduate Landscape Architectural Design III Fall. 5 credits. Prerequisite: Landscape Architecture 502. Cost of drafting supplies, about $100. Basic expenses for field trip, about $175.
Lec, F 9:05; studio, M W F 10:10–12:35; required 5-day field trip.
Application of town-planning and urban-design principles. Investigation of case studies. Timely urban projects are engaged, exposing students to field applications and community assistance programs.

602 (500) Graduate Landscape Architectural Design IV Spring. 5 credits. Prerequisite: Landscape Architecture 601. Cost of supplies, about $100.
Lec, F 12:20; studio, M W F 1:25–4:25.
Emphasis in this studio includes methods of conceptualizing design and the application of design principles to multidisciplinary professional projects.

***621 Summer Internship Seminar** Fall. 2 credits.

622 Graduate Design Research Seminar Spring.
2 credits. Prerequisite: Landscape Architecture 601.
T. H. Johnson.
Seminar focusing on the interrelationships between design-related research and personal expression. Qualitative research methods, thesis research and preparation, phenomenology, and scholarly publication are discussed.

***650 Fieldwork or Workshop in Landscape Architecture** Fall or spring. 1–5 credits. S-U grades optional.
L. Mirin.

***701 (501) Graduate Landscape Architectural Design V** Fall. 5 credits.

800 Master's Thesis in Landscape Architecture
Fall or spring. 9 credits. Limited to M.L.A. degree candidates. Prerequisite: permission of graduate field members concerned.
Staff.
Independent research under faculty guidance leading to the development of an original, comprehensive, and defensible design or study related to the field of landscape architecture.

*Offered through the College of Architecture, Art, and Planning.

Food Science

J. E. Kinsella, chairman; J. G. Babish, R. C. Baker, D. K. Bandler, D. M. Barbano, D. H. Beermann, D. C. Graham, R. B. Gravani, L. F. Hood, J. H. Hotchkiss, W. K. Jordan, F. V. Kosikowski, R. A. Ledford, F. W. Liu, R. P. March, D. D. Miller, N. N. Potter, J. M. Regenstein, G. E. Rehkugler, S. S. H. Rizvi, J. W. Sherbon, W. F. Shipe, Jr., J. R. Stouffer, G. H. Wellington, R. R. Zall

100 Introductory Food Science Fall. 3 credits.
M W F 10:10. N. N. Potter.
A comprehensive introduction to food science and technology—its scope, principles, and practices. Topics are constituent properties, methods of preservation, the major food groups including their handling and processing, and current problems such as chemical additives and world feeding needs. Interrelationships between chemical and physical properties, processing, nutrition, and food quality are stressed.

101 Topics in Food Science Fall. 1 credit. Limited to food science majors taking Food Science 100. Prerequisite: Food Science 100. A required companion course to Food Science 100.
Lec and disc, F 11:15. N. N. Potter and staff.
Members of the staff lecture and lead discussion on selected topics.

150 Food Choices and Issues Spring. 2 credits. S-U grades optional.
Lecs, T R 12:20. W. F. Shipe, staff, and invited speakers.
A series of lectures dealing with current topics relating to foods. Attempts are made to dispel misconceptions about foods and the factors affecting them.

210 Food Analysis Spring. 3 credits. Prerequisite: Chemistry 104 or 208.
Lecs, W F 12:20; lab, F 1:25–4:25 or M 7:30–10:30 p.m. J. W. Sherbon.
Designed to acquaint the student with chemical tests used by food analysts. Emphasis is on understanding and use of good analytical techniques, including gravimetric, volumetric, and spectrophotometric methods. Procedures for screening, routine quality control, and official tests for fats, proteins, carbohydrates, and selected minor nutrients are introduced.

220 Food Science for Industry Fall. 2 credits.
Lec and lab, F 12:20–4:25. Field trips. R. C. Baker.
Provides understanding of food industry operations. Half the laboratories are production of food products (such as sausages and pastries) by students and half are visits to commercial plants producing those products. One or two longer field trips may be offered.

247 Postharvest Food Systems Fall. 2 credits. Prerequisite: freshman chemistry. Recommended: Food Sciences 100. S-U grades optional.
T R 10:10. M. C. Bourne.
This interdisciplinary course describes various courses of postharvest food losses in developing countries and methods available to reduce the losses. Designed for all students in agriculture. Emphasis on cereal grains. Biology and control of rodents, birds, insects, and molds in stored foods, chemical causes of quality loss, simple drying and storage practices, effects of climate. Economic and social factors affecting food preservation and storage technology are discussed.

300 Physical Chemistry of Foods Fall. 3 credits Prerequisite: Mathematics 111 or equivalent.
Lecs, M W 11:15; disc, F 12:30–2:15 or 2:30–4:15. S. S. H. Rizvi.
An introduction to the principles of molecular structure, energetics, and kinetics is offered, with applications of these principles to food systems and similar biological materials. Topics include thermodynamics, properties of solutions, phase equilibria, reaction mechanisms, and transport phenomena.

301 Nutritional Aspects of Raw and Processed Foods (also Nutritional Sciences 301) Spring
3 credits. Prerequisites: Nutritional Sciences 115 and organic chemistry or permission of the instructor.
M W F 9:05. D. Miller.
An evaluation of the nutritional qualities of human foods, with emphasis on changes that occur during processing and storage. Topics include criteria and methods for nutritional evaluations of foods, factors which may affect nutrient loss, descriptions of the composition and nutritional role of selected commodities, food fortification, food additives, fabricated foods, fast foods, and minimally processed foods.

302: Introduction to Food Engineering Fall.
4 credits. Prerequisites: Food Science 100 and physics.
Lecs, M W F 10:10; lab, M 1:25–4:25. W. K. Jordan.
Engineering aspects of dairy and food plant operations.

304 Food Sanitation as Related to Public Health
Spring. 3 credits. Prerequisite: Food Science 100.
Lecs, T R 10:10; lab, R 1:25. R. R. Zall.
Deals with the sanitary principles and control measures essential in producing and processing wholesome and safe foods. Rules and regulations of the U.S. Public Health Service, the Food and Drug Administration, the U.S. Department of Agriculture, and other organizations important to the food industry are covered.

[311 Milk and Frozen Desserts Fall. 2 credits. Prerequisite: Food Science 100 or equivalent or permission of instructor. Offered alternate years. Not offered 1982–83.
Lec, W 12:20; lab, W 1:25. W. K. Jordan, R. R. Zall.
Deals with the principles and practices of processing fluid milk products and frozen desserts. The chemical, microbiological, and technological aspects of processing these dairy products are considered. Field trips to processing plants supplement the lectures and laboratory work.]

351 Milk Quality Spring. 1 credit. Prerequisite: Animal Science 350 (may be taken concurrently) or permission of instructor.
Lec, F 12:20. D. K. Bandler, R. R. Zall.
Aspects of farm sanitation and milk handling as they apply to milk quality. Quality control tests, farm bacteriology, cleaning, and sanitizing. Special problems of marketing fresh and manufactured dairy products.

394 Food Microbiology Lectures Spring.
2 credits. Prerequisites: Microbiology 290 and 291.
M W 12:20. R. A. Ledford.
The major families of microorganisms of importance in foods are studied systematically, with emphasis on the roles of these organisms in food preservation, food fermentations, and public health.

395 Food Microbiology Laboratory Spring
2 credits. Graduate students must have permission of the instructor.
M W 2–4:25. R. A. Ledford.
Work includes study of the physiological characteristics of representative food microorganisms, practice in using general and special methods for microbiological testing and control of food products, and practice in isolating and characterizing organisms of importance in foods.

[401 Concepts of Product Development Spring
2 credits. Prerequisite: Food Science 100 or equivalent. S-U grades optional. Offered alternate years. Not offered 1982–83.
M W 10:10.

A discussion of the sequence of events in developing and marketing new food products. Topics include packaging and labeling, food additive and ingredient regulations, taste panels, market testing, market research, and patents.]

[402 Product Development Laboratory Spring. 2 credits. Limited to food science majors. Prerequisite: concurrent registration in Food Science 401 and permission of instructor. S-U grades optional. Offered alternate years. Not offered 1982–83.
Labs, M W 1:25–4:25.
Emphasis is on gaining practical experience in the development of new foods.]

403 International Food Science and Development Fall. 3 credits. Offered alternate years.
Lecs, T R 11:15; disc, R 1:25–4:25.
F. V. Kosikowski.
A critical evaluation of man's needs for food in the world and the international food technologies, organizations, and policies to meet such needs. Novel extrusion, ultrafiltration, and fermentation food processes and basic nutrient foods for developing countries are described. The making of representative high-energy and protein foods, including soybean milk, tofu, sufu, and tempeh is demonstrated.

[404 Food Processing I—Drying, Freezing, Heat Preservation Spring. 3 credits. Prerequisite: Food Science 100 or equivalent. Offered alternate years. Not offered 1982–83.
Lecs, T R 11:15; lab, T 1:25–4:25. N. N. Potter.
Deals with the principles and practices of drying, freezing, canning, and other heat treatments applied to foods. Current processing methods and their relations to the chemistry, microbiology, and technology of the ingredients and final products are discussed.]

405 Food Processing II—Concentrating, Separating, Mixing Spring. 3 credits. Prerequisites: Food Science 302 and Microbiology 290 and 291. Offered alternate years.
Lecs, T R 11:15; lab, T 1:25–4:25. W. K. Jordan, R. R. Zall.
Deals with the principles and practices of evaporation, reverse osmosis, homogenization, size reduction, waste management, and other unit operations important to the food industry.

[406 Food Processing Fermentations Lecture Fall. 3 credits. Prerequisite: background in microbiology. Offered alternate years. Not offered 1982–83.
Lecs, T R 11:15; disc, R 1:25–4:25.
F. V. Kosikowski.
Principles and practices of viniculture and enology, cheese and cultured-milk technology, and related fermentations leading to important foods from fruits, grains, and vegetables, and milk, animal, and microbial sources. Taste evaluations and illustrated descriptions of wines, beers, cheeses, cultured milks, and exotic fermented foods are included.]

[408 Food Processing Fermentations Laboratory Fall. 2 credits. Enrollment limited. Prerequisite: concurrent registration in Food Science 406. Offered alternate years. Not offered 1982–83.
Lab, T 1:25–4:25; required short field trips.
F. V. Kosikowski.
Laboratory exercises and demonstrations in the making of wines, beers, cheeses, cultured milks, and vegetable foods. Field trips provide additional experience.]

409 Food Chemistry Fall. 3 credits. Prerequisite: Biological Sciences 330 or 331.
Lecs, T R 8–9:25. W. F. Shipe, L. F. Hood, J. E. Kinsella, J. M. Regenstein.
Deals with the relationship between the chemical composition and properties of foods. Attention is given to the interactions among the components of food.

410 Sensory and Objective Evaluations of Foods Spring. 3 credits. Prerequisite: statistics.
Lecs, M W F 11:15. W. F. Shipe.
Deals with the sensory techniques used in evaluating the flavor, color, and texture of foods and the effects of these properties on consumer acceptance. Objective methods for measuring these qualities, and appropriate statistical methods for analyzing the subjective and objective results and establishing a quality-control program.

[411 Food Mycology Fall. 3 credits. Prerequisite: Microbiology 290 or 291 or equivalent. Recommended: Microbiology 394. Offered alternate years. Not offered 1982–83.
Lecs, T R 10:10; lab, W 1:25–4:25. D. C. Graham.
To acquaint students with important fungi, from the standpoint of their beneficial as well as their harmful effects in food production, preservation, and spoilage. Laboratories deal with morphology, culture and isolation, identification of fungi, and isolation and quantification of fungal toxins.]

[413 Function of Food Ingredients Spring. 1 credit. Prerequisite: Food Science 409. S-U grades optional. Offered alternate years. Not offered 1982–83.
Lec, F 10:10.
Intended for food science majors anticipating product development, production, or quality-control assignments in the food industry. Functional properties of classes of ingredients and their potential interactions with other food constituents are discussed. Guest lecturers from ingredient suppliers participate.]

415 Principles of Food Packaging Fall. 3 credits.
Lecs, M W F 9:05. J. H. Hotchkiss.
Intended primarily for students in food science and related fields. The basic properties of some packaging materials and systems are discussed and applied to specific packaging systems for meats, dairy products, fruits and vegetables, fats and oils, et cetera.

419 Food Chemistry Laboratory Fall. 2 credits. Prerequisites: Biological Sciences 330 or 331 and concurrent registration in Food Science 409.
Lab, T 1:25–4:25. D. Miller.
Intended to complement Food 409 in developing an understanding of the chemistry of food. Laboratory exercises deal with the chemical properties of food components and changes these components undergo in processing and storage. The relationship between the chemical composition of foods and functional, nutritional, and organoleptic properties are stressed.

497 Special Topics in Food Science Fall or spring. 3 credits maximum. Prerequisite: permission of instructor. S-U grades optional.
Staff.
For the food science student. May include individual tutorial study, a special lecture topic selected by a professor or a group of students, or selected lectures of a course already offered. As topics may be changed, the course may be repeated for credit.

499 Undergraduate Research in Food Science Fall or spring. 4 credits maximum. S-U grades optional. Students must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade. Except for students enrolled in the honors program, credit will be limited to 4 credits total.
Hours to be arranged. Staff.
Independent study.

600 Seminar Fall or spring. 1 credit. Required of all food science graduate students. S-U grades only.

[601 Food Protein Chemistry Fall. 3 credits. Limited to graduate students and to seniors with permission of the instructor. Prerequisite: Food Science 300 or its equivalent. Students who have already had Biological Sciences 631 may not take this course for credit. Offered alternate years. Not offered 1982–83.
Lec, M W F 10:10. J. M. Regenstein.
The chemistry and physical chemistry of proteins are discussed. Important proteins of food systems are examined in terms of methodology currently used in protein chemistry for characterization and purification. Interactions of proteins with other food components are also covered.]

[603 Food Carbohydrates Spring. 2 credits. Limited to qualified seniors and graduate students. Prerequisite: Biological Sciences 330 or equivalent. Offered alternate years. Not offered 1982–83.
Lecs, T R 10:10. L. F. Hood, R. S. Shallenberger.
A consideration of the chemistry of carbohydrates in foods including sugars, starches, pectins, gums, and cellulose. Emphasis is on their intrinsic chemistry, their origins in raw materials, and the subsequent changes occurring during processing and storage.]

604 Chemistry of Dairy Products Fall. 2 credits. Prerequisites: organic chemistry, biochemistry, and knowledge of dairy-product manufacturing procedures. Offered alternate years.
Lecs, T R 12:20. D. M. Barbano.
A detailed study of milk constituents and their properties. Properties of various milk constituents are related to observed physical and chemical changes that occur in dairy products during and after processing. This course will emphasize current research in dairy chemistry.

606 Instrumental Methods Fall. 5 credits. Prerequisite: permission of instructor.
Lec, M W F 8; lab, W or R 1:25–4:25.
J. W. Sherbon.
Deals with instrumental methods widely used in research and industry. The major emphasis is on chromatography, spectroscopy, electrophoresis, thermal analysis, and the use of computers. The stress is on the theoretical and practical aspects of the material presented.

[608 Food Color and Food Pigments Fall. 1 credit. Prerequisite: organic chemistry. Offered alternate years. Not offered 1982–83.
Lec, F 12:20. J. P. VanBuren.
An introduction to theories of color perception and color spaces, followed by a survey of chemical and physical properties of the major food pigments and their stability during processing and storage. Color and pigments of selected commodities are examined.]

[609 Rheology Fall. 1 credit. Offered alternate years. Not offered 1982–83.
Lec, T 12:20. M. C. Bourne.
Fundamental concepts of rheology applied to foods, with emphasis on objective methods for measuring textural properties. Principles and practice involved in measuring texture, viscosity, texture profiling, and consistency; instrumentation and correlations between objective and sensory methods of texture measurements. Examples of rheological problems in each major food group.]

[610 Introductory Chemical Toxicology Fall. 2 credits. Prerequisites: biochemistry and animal physiology. Offered alternate years. Not offered 1982–83.
Lec, T R 11:15. G. S. Stoewsand, J. G. Babish, D. J. Lisk.
An introduction to the concepts and essentials of toxicology; discussions will include sources, modes of toxicity, harmful effects, and remedial measures as they pertain to humans and the whole environment. Toxicants will include pesticides, heavy metals, air pollutants, industrial poisons, natural toxicants, food additives, drugs, social poisons, and ionizing radiation.]

[614 Mathematical Evaluation of Processed Packaged Foods Spring. 3 credits. Offered alternate years. Not offered 1982–83.
Lec and disc, R 2–4:25.

Mathematical methods used to evaluate the thermal processing of packaged foods are presented in depth. These techniques are used in predicting shelf life and nutrient loss.]

615 Secondary Plant Metabolites in Foods Fall. 1 credit. Prerequisite: Biological Sciences 330 or 331. Offered alternate years.
Lec, F 12:20. G. Hrazdina.
Deals with the biochemistry of secondary plant metabolites (e.g., sulphur-containing compounds, alkaloids, flavonoids, terpenes) and their importance to food products. Emphasis is on the chemical properties of these compounds, their reactions, their occurrence in edible plants, and their influence on food products.

Related Courses in Other Departments

Marketing (Agricultural Economics 240)

Food Industry Management (Agricultural Economics 443)

Introduction to Agricultural Engineering and Computing (Agricultural Engineering 151)

Engineering Design and Analysis of Food Processing Equipment (Agricultural Engineering 466)

Meat and Meat Products (Animal Science 290)

Commercial Meat Processing (Animal Science 490)

Advanced General Microbiology Lectures (Microbiology 390)

Postharvest Handling and Marketing of Vegetables (Vegetable Crops 312)

International Agriculture

300 Perspectives in International Agriculture and Rural Development Fall. 2 credits. S-U grades optional.
F 1:25–3:20. Staff.
A forum to discuss both contemporary and future world food issues and the need for an integrated, multidisciplinary team approach in helping farmers and rural development planners adjust to the ever changing food needs of the world.

599 International Agriculture and Rural Development Project Paper Fall and spring. 1–6 credits. Limited to M.P.S. candidates in international agriculture and rural development. S-U grades only.
Staff.

600 Seminar: International Agriculture Fall and spring. Noncredit. S-U grades only.
Third and fourth Wednesdays of each month, 4–5.
Staff.
The seminar focuses on developing an understanding of the nature and interrelatedness of agricultural development and the social sciences, plant and animal sciences, foods and nutrition, and natural resources.

602 Special Studies of Problems of Agriculture in the Tropics Spring. 3 credits. Prerequisites: an international agriculture course and permission of instructors. Cost of field-study trip, estimated at $800 for lodging, meals, personal expenses, and transportation.
R 2:30–4:25. Staff.
Oriented to provide students an opportunity to observe agricultural development in a tropical environment and promote interdisciplinary exchange among staff and students. The two-week field-study trip during January to Latin American countries is followed by discussions and assignments dealing with problems in agriculture and livestock production in the context of social and economic conditions.

603 Administration of Agricultural and Rural Development (also Government 692 and B&PA NCE 514) Spring. 3 credits. S-U grades optional.
T 2:30–5:30. M. L. Barnett, J. L. Compton, M. J. Esman, N. T. Uphoff, L. W. Zuidema.
An intercollege course designed to provide graduate students a multidisciplinary perspective on the administration of agricultural and rural development activities in developing countries. The course is oriented to students trained in agricultural and social sciences who are likely to occupy administrative roles during their professional careers.

604 Seminar on African Agriculture and Rural Development Fall. 2 credits. S-U grades optional.
M 1:25–3:20. Staff.
Strategies for increasing food production and raising rural incomes in Africa. Topics include cropping systems in Africa and the role of agricultural technology in increasing yields and improving livestock production; strategies for improving human nutrition; food storage and mechanization; rural employment projects; alternative rural development strategies; and experience with World Bank and other internationally funded rural development projects.

605 Chinese Agricultural and Rural Development Fall. 3 credits. S-U grades optional.
T R 12:20–2:15. M. L. Barnett, R. Barker.
A multidisciplinary seminar dealing with the economic, social, and technical aspects of agricultural modernization in China. The course will explore changing strategies for agricultural and rural development and review the China experience against developmental efforts in other countries.

606 Farming Systems Research Fall. 3 credits. S-U grades optional. T 2:30–4:25, R 12:30–1:25.
R. Barker, M. Barnett, H. C. Wien.
An interdisciplinary course focusing on the development of agricultural technologies and policies designed to assist small-scale farmers in developing countries. Techniques for gathering information, specifying research problems, and analyzing and interpreting data will be explored. The involvement of farmers in the research process is stressed.

650 Special Topics in International Agricultural and Rural Development Fall and spring. 1–3 credits. S-U grades optional.
Staff.
A seminar on current themes of agricultural and rural development. Specific content varies each semester.

703 Seminar for Special Projects in Agricultural and Rural Development Spring. 1 credit. Required for graduate students enrolled in the M.P.S.(Agr.) degree program and majoring in international agricultural and rural development; others with permission of the program director. S-U grades only.
Hours to be arranged. Staff.
The seminar provides students the opportunity to present their special projects. It also serves as a forum for discussion of current issues in low-income agricultural and rural development, with particular attention to interdisciplinary complexities.

Related Courses in Other Departments

Economics of Agricultural Geography (Agricultural Economics 150)

Agricultural Trade Policy (Agricultural Economics 430)

Economics of Agricultural Development (Agricultural Economics 464)

Food, Population, and Employment (Agricultural Economics 660–661)

Macroeconomic Issues in Agricultural Development (Agricultural Economics 663)

Microeconomic Issues in Agricultural Development (Agricultural Economics 664)

Seminar on Latin American Agricultural Policy (Agricultural Economics 665)

Seminar in Agricultural Development (Agricultural Economics 666)

Seminar on Agricultural Trade Policy (Agricultural Economics 730)

Export Marketing (Agricultural Economics 743)

Agricultural Mechanization: An International Perspective (Agricultural Engineering 211)

Production of Tropical Crops (Agronomy 314)

Geography and Appraisal of Soils of the Tropics (Agronomy 401)

[Management Systems for Tropical Soils (Agronomy 480) Not offered 1982–83.]

Livestock Production in Warm Climates (Animal Science 400)

[Forages of the Tropics for Livestock Production (Animal Science 403) Not offered 1982–83.]

Seminar in Science and Technology Policy in Developing Nations (City and Regional Planning 771)

Seminar in Policy Planning in Developing Nations: Technology Transfer and Adaption (City and Regional Planning 772)

Seminar in Project Planning in Developing Countries (City and Regional Planning 773)

Intercultural Communication (Communication Arts 601)

[Communication in the Developing Nations (Communication Arts 624) Not offered 1982–83.]

Designing Extension and Continuing Education Programs (Education 681)

Community Education (Education 682)

Behavioral Change in International Rural Modernization (Education 782)

Comparative Extension Education (Education 783)

Arthropods of World Importance (Entomology 341)

Postharvest Food Systems (Food Science 247)

International Food Sciences and Development (Food Science 403)

Political Economy of Change: Rural Development in the Third World (Government 648)

Regional Landscape Planning I (Landscape Architecture 531)

Regional Landscape Planning II (Landscape Architecture 532)

National and International Food Economics (Nutritional Sciences 457)

International Nutrition Problems, Policy, and Programs (Nutritional Sciences 680)

Seminar in International Nutrition and Development Policy (Nutritional Sciences 695)

Special Topics in International Nutrition (Nutritional Sciences 699)

[Plant Diseases in Tropical Agricultural Development (Plant Pathology 655) Not offered 1982–83.]

[Economic Fruits of the World (Pomology 208) Not offered 1982–83.]

Rural Sociology and World Development Problems (Rural Sociology 105)

[Social Indicators and Data Management in Poor Countries (Rural Sociology 213) Not offered 1982–83]

Rural Development and Cultural Change (Rural Sociology 355)

Subsistence Agriculture in Transition (Rural Sociology 357)

Rural Social Stratification (Rural Sociology 445)

Contemporary Sociological Theories of Development (Rural Sociology 606)

[Social Organization of Agriculture (Rural Sociology 650) Not offered 1982–83.]

[Macrosocial Accounting (Rural Sociology 715) Not offered 1982–83.]

[Social Movements in Agrarian Society (Rural Sociology 723) Not offered 1982–83.]

Sociotechnical Aspects of Irrigation (Rural Sociology 754)

Landscape Architecture

The Landscape Architecture Program at Cornell is sponsored by the College of Agriculture and Life Sciences through the Department of Floriculture and Ornamental Horticulture and the College of Architecture, Art, and Planning. For course descriptions, see pp. 56–57.

Microbiology

R. P. Mortlock, chairman; E. A. Delwiche, N. C. Dondero, W. C. Ghiorse, E. P. Greenberg, C. M. Rehkugler, P. J. VanDemark, S. H. Zinder

100 Microbes and Human Affairs Spring. 3 credits. Not to be taken for credit after Micro 290.
M W F 11:15. S. H. Zinder.
Development of microbiology as a science. Basic characteristics of microorganisms. Importance of microorganisms in medicine, environment, agriculture, and industry. Recent advances in microbial technology, including genetic engineering.

290 General Microbiology Lectures Fall or spring. 3 credits. Prerequisites: Biological Sciences 101–102 and Chemistry 104 or 208. Recommended: concurrent registration in Microbiology 291.
M W F 9:05 (spring only) or 11:15. Evening exam: spring, March 1, April 14, and May 5. Fall, W. C. Ghiorse; spring, P. J. VanDemark.
A study of the basic principles and relationships in the field of microbiology, with fundamentals necessary for further work in the subject.

291 General Microbiology Laboratory Fall or spring. 2 credits. Prerequisite: Microbiology 290 (may be taken concurrently).
M W 2–4:25 or T R 8–10:30, 11:15–1:45, or 2–4:25. Fall, W. C. Ghiorse; spring, P. J. VanDemark; summer, staff.
A study of the basic principles and techniques of laboratory practice in microbiology, and fundamentals necessary for further work in the subject.

292 General Microbiology Discussion Spring 1 credit. Prerequisite: Microbiology 290 (may be taken concurrently). S-U grades only.
Hours to be arranged. P. J. VanDemark.
A series of discussion groups in specialized areas of microbiology to complement Microbiology 290.

314 Tissue Culture Techniques and Applications Fall. 2 credits. Prerequisites: Microbiology 290 and 291 or permission of instructor.
F 1:25–3:30; 3 lab exercises scheduled on a rotating basis, F 3:30–5:30. C. M. Rehkugler.
A series of lectures and demonstrations dealing with cell culture methods, especially those required to culture cells of plants and animals from different tissue origins. The application of cell culture to the study of bacterial diseases, virus replication, and the production of biologicals is considered.

336 Applied and Industrial Microbiology Fall. 3 credits. Prerequisites: Microbiology 290 and organic chemistry.
T R 10:10–11:25. E. A. Delwiche, N. C. Dondero, and staff.
A survey of the microbiology of industrial fermentations and public health aspects of water and wastewater.

[390 Advanced General Microbiology Lectures Fall. 2 credits. Prerequisites: Microbiology 290 and 291 and organic chemistry. May be taken independently of Microbiology 391 and in sequence with, or independently of, Microbiology 392. Offered alternate years. Not offered 1982–83.
M W 11:15. E. A. Delwiche, N. C. Dondero.
A consideration of the morphological, taxonomic, cultural, and physiological characteristics of important groups of heterotrophic microorganisms. Included will be (1) spore-forming bacteria, propionic acid bacteria, and gram-negative cocci, and (2) pseudomonads, enterics, and related forms.]

[391 Advanced General Microbiology Laboratory Fall. 2 credits. Limited to 20 students. Prerequisite: Microbiology 390 (may be taken concurrently). Offered alternate years. Not offered 1982–83.
M W 2–4:25. E. A. Delwiche, N. C. Dondero.
Intended as a laboratory complement to Microbiology 390. The isolation, characterization, and study of the groups of heterotrophic microorganisms included in Microbiology 390.]

392 Advanced General Microbiology Lectures Fall. 2 credits. Prerequisites: Microbiology 290 and 291 and organic chemistry. May be taken independently of Microbiology 393 and in sequence with, or independently of, Microbiology 390. Offered alternate years.
M W 11:15. P. J. VanDemark, E. P. Greenberg.
A consideration of the morphological, taxonomic, cultural, and physiological characteristics of important groups of heterotrophic microorganisms. Included are (1) lactic acid bacteria and (2) marine bacteria, thermophilic bacteria, and halophilic and halotolerant bacteria.

393 Advanced General Microbiology Laboratory Fall. 2 credits. Limited to 20 students. Prerequisite: Microbiology 392 (may be taken concurrently). Offered alternate years.
M W 2–4:25. P. J. VanDemark, E. P. Greenberg.
Intended as a laboratory complement to Microbiology 392. The isolation, characterization, and study of the groups of heterotrophic microorganisms included in Microbiology 392.

412–413 Clinical Microbiology 412 fall; 413 spring. Credits to be arranged. Prerequisite: permission of instructor.
Hours to be arranged. R. P Mortlock, P. J. VanDemark.
Training and practical experience in clinical microbiology in the hospital laboratory of the Cornell Medical College and New York Hospital in New York City. Emphasis will be upon developing the student's capability in the isolation and rapid identification of organisms from various types of clinical specimens. This course is intended to prepare the student for state and federal licensing in various areas of clinical microbiology.

422 Aquatic Microbiology Spring. 3 credits. Prerequisites: Microbiology 290 or Agronomy 406, and organic chemistry.
T R 10:10–11:25.
A consideration of the relation of microorganisms, especially the bacteria, to aquatic environments, both natural and artificial. The microbiology of wastewaters is included. Attention is given to fundamental biological concepts and to applied aspects of the occurrence and activities of microorganisms in water.

466 Microbial Ecology Spring. 3 credits. Prerequisite: an elementary course in some facet of microbiology. Offered alternate years.
M W F 10:10. M. Alexander.
An introduction to the basic principles of microbial ecology. Attention is given to the behavior, activity, and interrelationships of bacteria, fungi, algae, and protozoa in natural ecosystems.

480 Microbial Physiology Lectures Spring. 3 credits. Prerequisites: Microbiology 290 and 291 and biochemistry. S-U grades optional.
M W F 11:15. R. P. Mortlock.
The concern is with the physiological functions of microorganisms. Consideration is given to chemical structure, regulation, growth, and the energy metabolism of prokaryotic organisms. Special attention given to those aspects of microbial metabolism and carbohydrate catabolism not normally studied closely in biochemistry courses.

481 Microbial Physiology Laboratory Spring. 3 credits. Limited to 12 students. Prerequisites: Microbiology 480 (may be taken concurrently) and permission of instructor. S-U grades optional.
T R 12:20–4:25. R. P. Mortlock.
The laboratory component of Microbiology 480. Deals with laboratory experiments and techniques used in studying the physiological characteristics of microorganisms.

484 Cytology of Prokaryotes Lectures Spring. 3 credits. Prerequisites: Microbiology 290 and 291, and biochemistry. S-U grades optional. Offered alternate years.
M W F 9:05. W. C. Ghiorse.
An in-depth survey of morphology and life cycles of prokaryotic organisms. Form, organization, and function are considered with respect to aggregates of cells, individual cells, sub-cellular organelles, and macromolecular architecture.

485 Cytology of Prokaryotes Laboratory Spring. 2 credits. Enrollment limited. Prerequisite: concurrent registration in Microbiology 484 and permission of instructor. Offered alternate years.
Hours to be arranged. W. C. Ghiorse.
Cytological techniques, including preparations for light and electron microscopy, that are especially applicable to the study of prokaryotic cells.

486 Selected Topics in Microbial Metabolism Spring. 2 credits. Primarily for upperclass and graduate students. Prerequisites: beginning courses in general microbiology, biochemistry, and organic chemistry. S-U grades optional.
T R 11:15. E. A. Delwiche.
Selected topics pertaining to the energy metabolism, oxidative and fermentative abilities, and biosynthetic capacities of microorganisms. Where possible and appropriate, the subject matter compares the various microbial forms.

497 Special Topics Fall. 1 credit. Limited to upperclass students specializing in microbiology who may desire to take Microbiology 499. Prerequisite: permission of instructor. S-U grades only. The course cannot be used to fulfill the specialization requirement.
Hours to be arranged. Staff.

498 Teaching Experience Fall or spring. 1–3 credits. Enrollment limited. Prerequisites: previous enrollment in the course to be taught or equivalent, and written permission of instructor. S-U grades with permission of instructor.
Hours to be arranged. Staff.
Designed to give qualified undergraduate students teaching experience through actual involvement in planning and teaching microbiology courses under supervision of departmental faculty. This experience may include leading a discussion group; preparing, assisting, or teaching a microbiology laboratory; or tutoring. Microbiology courses currently offering such experience include 291 and 292. This course cannot be used to fulfill the specialization requirement.

499 Research in Microbiology Fall or spring. Variable credit. Undergraduates must attach to their course enrollment material written permission of the staff member who will supervise the work and assign the grade. This course cannot be used to fulfill the specialization requirement.
Hours to be arranged. Staff.

691 Graduate Seminar in Microbiology Fall and spring. 1 credit each semester. All students in the graduate field of microbiology must enroll each semester until they have completed their A exam.
Hours to be arranged. Staff.

694 Bacterial Diversity Spring. 4 credits. Prerequisites: either Microbiology 390, 392, or 480, and Biological Sciences 330 or 331 or equivalent.
M W 12:20–4:25. E. P. Greenberg.
Physiology, ecology, and morphology of selected groups of bacteria, including the methanogenic bacteria, spirochetes, nitrogen-fixing bacteria, photosynthetic bacteria, thermophilic bacteria, myxobacteria, and others. Behavior of bacteria in response to environmental stimuli.

699 Microbiology Seminar Fall and spring. Required of all graduate students majoring in microbiology and open to all who are interested.
Hours to be arranged. Staff.

Related Courses in Other Departments

[Soil Microbiology (Agronomy 406)]

Advanced Soil Microbiology (Agronomy 606)

Insect Pathology (Entomology 453)

Food Microbiology Lectures (Food Science 394)

Food Microbiology Laboratory (Food Science 395)

Food Mycology (Food Science 411)

Basic Immunology, Lectures (Veterinary Medicine 315, also Biological Sciences 305)

Basic Immunology, Laboratory (Veterinary Medicine 316, also Biological Sciences 307)

Pathogenic Microbiology (Veterinary Medicine 317) Spring. 4 credits. Primarily for graduate and undergraduate microbiology majors. Limited to 48 students. Prerequisites: Microbiology 290, 291, and Veterinary Medicine 315; or permission of instructor. Recommended: Veterinary Medicine 316.
Lec, T R 1:05; lab, T R 2:05–4:25. G. M. Dunny, J. H. Gillespie, K. M. Lee.
Two-part course in medical microbiology, covering pathogenic bacteriology and virology. One important principle emphasized in both portions of the course is that disease is the product of the interaction of host, pathogen, and environment.

Microbial Genetics, Lectures (Biological Sciences 485)

Microbial Genetics, Laboratory (Biological Sciences 486)

Advanced Immunology, Lectures (Veterinary Medicine 705)

[Advanced Immunology, Laboratory (Veterinary Medicine 706)]

Advanced Work in Bacteriology, Virology, or Immunology (Veterinary Medicine 707)

Advanced Animal Virology, Lectures (Veterinary Medicine 708)

Advanced Animal Virology, Laboratory (Veterinary Medicine 709)

Immunopathology and Clinical Immunology (Veterinary Medicine 712)

Natural Resources

W. H. Everhart, chairman; R. A. Baer, H. B. Brumsted, J. W. Caslick, T. J. Fahey, T. A. Gavin, S. P. Gloss, E. E. Hardy, R. A. Howard, T. L. Hullar, J. W. Kelly, J. P. Lassoie, D. A. McCrimmon, R. J. McNeil, R. A. Malecki, A. N. Moen, R. R. Morrow, Jr., R. T. Oglesby, M. E. Richmond, C. L. Schofield, C. R. Smith, D. A. Webster, L. H. Weinstein, B. T. Wilkins, W. D. Youngs

200 Principles of Conservation Fall. 3 credits. Limited to natural resources majors. Not open to students who have passed Natural Resources 201.
Lecs, M W F 10:10; 1-hour disc to be arranged. R. J. McNeil.
Principles of environmental conservation and application of those principles to the management of natural resources. Ecological concepts, a survey of the natural resources and their properties, and resource management concepts are considered. Social, political, legal, economic, and ethical aspects of environmental issues are discussed.

201 Environmental Conservation Spring. 3 credits. Not open to students who have passed Natural Resources 200.
Lecs, M W F 10:10; 1-hour disc to be arranged. R. J. McNeil.
A survey course intended for students in any year and major. People, natural resources, and environment. Ecological principles as applied to human use of environment; survival strategies of animals and the application of these concepts to human use and misuse of environment; a survey of natural resources and problems related to their management. Current issues such as air and water pollution, disposal of radioactive wastes, human population pressures, energy supply and management, and life-style are considered. Social, political, legal, economic, and ethical aspects of environmental concerns are introduced.

210 Introductory Field Biology Fall. 3 credits. Limited to 45 students. Preference given to sophomores and transfer students in natural resources. Prerequisites: Biological Sciences 101 and 102 or equivalent. Cost of field trips, no more than $10.
Lec, W 9:05; labs, M W 1:25–4:25; overnight field trips. T. A. Gavin.
Introduction to methods of inventorying and identifying plants and animals. Recognition and knowledge of approximately 150 species of vertebrates and 75 species of woody plants found in New York State will be covered. Selected aspects of current ecological thinking relevant to problems in assessment of the distribution and abundance of organisms are stressed. The interaction of students with biological events in the field and accurate recording of these events are emphasized.

250 Introductory Wildlife Biology Spring, first third of term. 1 credit. Prerequisite: Natural Resources 210 or permission of instructor.
Lecs, M W F 8. A. N. Moen.
Introduction to the biological characteristics of wildlife species, with analyses of these characteristics in relation to ecology and management.

251 Introductory Fishery Biology Spring, middle third of term. 1 credit. Prerequisite: Natural Resources 210 or permission of instructor.
Lec, M W F 8. Staff.
Importance of basic life history, ecology, and measurable parameters as a basis for fishery management. Representative commercial and recreational fisheries will be used as examples.

252 Introductory Forestry Spring, last third of term. 1 credit. Prerequisite: Natural Resources 210 or permission of instructor.
Lec, M W F 8; field trip, all day on one S.
R. R. Morrow.
Appreciation of forests as a natural resource. Importance of ecology and measurement as bases for forest management. Introduction to tree biology and silviculture.

260 Introduction to Consumptive Wildlife Recreation Fall. 2 credits. Limited to 30 students. Prerequisites: natural resources majors or permission of instructor. Cost of overnight field trip, no more than $10.
Lec, M F 9:05. Overnight field trip and 1 evening lab. R. A. Howard.
Brief history of trapping and hunting; role of consumptive recreationists in conservation; firearms and archery nomenclature, function, ballistics, and safety; content of New York State hunter training, bowhunter education, and trapper training courses; discussion of current methods, laws, ethics, basic shooting instruction with rifles and shotguns; field exercise at Arnot Forest.

300 Natural Resources Inventories Spring. 3 credits.
Lecs, M W 12:20; lab, M T W 2. E. E. Hardy.
Procedures for inventorying resources, the methods used, and theories of inventory development in relation to present needs. Examination of the processes used in generating currently used inventories, application of methods to improve existing inventories, and experience in developing inventories. Land resource inventories are emphasized.

302 Forest Ecology Fall. 3 credits. Limited to seniors and graduate students. Cost of trip, no more than $20.
Lecs, M W 11:15; lab M 1:25–4:25; 1 weekend trip S through M. T. J. Fahey.
Understanding the wildland environment. Development of ability to identify and analyze what is present, what was present, and what is likely to happen in various forest ecosystems. All laboratory sessions in the field. One required weekend trip to the Adirondacks or other major forest region.

303 Woodland Management Fall. 3 credits. S-U grades optional.
Lecs, T R 11:15; lab, R 1:25–4:25 (one field trip will end at 5:30). R. R. Morrow.
Designed to give the student the basic information necessary to make sound woodland-management decisions. Field trips to woodlots emphasize variations in value and potential as well as biological growth. Introduction to tree identification, tree

valuation, timber estimating, tree marking, and stand improvement work. Planting, management, harvesting, marketing, and multiple use are discussed, as well as relationships of forestry to people and to the environment.

305 Maple Syrup Production Spring. 1 credit. S-U grades only. Limited to 20 students. Prerequisite: permission of instructor.
T 12:20–4:25 (3 preliminary seminars, followed by several half-days of fieldwork during the maple season). R. R. Morrow, A. Fontana.
Students work in most phases of the Arnot Forest maple operation and learn modern sap-collecting techniques and quality control in making syrup. A 100-tap area is reserved for student installation of a tubing sap-collection network.

320 Winter Energetics Spring. 1 credit. Prerequisite: Natural Resources 250.
Lec, lab, and disc, all day M T W R F in residence at Arnot Forest. A. N. Moen.
Field measurements of weather and range conditions in the winter will be related to metabolism, nutrition, and behavior of free-ranging animals at the Arnot Forest during the last week of the January intersession period.

330 Ecological Integration Summer or fall. 4 credits. Prerequisite: Natural Resources 250 or permission of instructor.
Lec, lab, and disc, all day M T W R F in residence at Arnot Forest. A. N. Moen.
Measurements and analyses of weather, watershed, plant community, and animal population characteristics in an integrated ecological way, stressing interrelationships within ecosystems. This course will be held at the Arnot Forest during the three-week summer session beginning the week after Commencement.

407 Religion, Ethics, and the Environment Spring. 3 credits. For juniors, seniors, and graduate students; others by permission. S-U grades optional.
T R 9:05, 1-hour disc to be arranged. R. A. Baer.
A study of the effects of Western religion and values on our understanding and treatment of nature. Historical overview, followed by consideration of selected themes including progress, play and work, objectivity and subjectivity, human finitude and death, and knowledge as control. Also, responsibility to future generations; limiting growth and questions of distributive justice; world population and global hunger; nuclear holocaust and the environment; implications of environmental programs for minorities, the poor, and other nations; land use; and energy policy.

410 Principles of Wildlife Management Fall. 4 credits. Limited to 36 students. Preference given to seniors in Natural Resources. Prerequisites: Natural Resources 210 and Biological Sciences 360, or permission of instructor. Cost of field trips, no more than $10.
Lecs, M W F 10:10; lab, F 1:25–4:25; one weekend field trip required. T. A. Gavin.
Stresses the application of ecological, behavioral, and genetic principles to management of wild vertebrate populations. Encourages student development of a theoretical-biological framework on which to base management decisions. Provides students with a sense of the history of wildlife management in North America and a feeling for its future.

411 Techniques in Wildlife Science Spring. 2 credits. Prerequisite: Natural Resources 410 or permission of instructor.
Lec, F 12:20; lab, F 1:25–4:25. J. W. Caslick.
An introduction to techniques used in wildlife research and management, with emphasis on field methods and northeastern game species.

414 Selected Topics in Wildlife Resource Policy Spring. 2 credits. Intended for juniors and seniors. Prerequisite: Natural Resources 410 or equivalent or permission of instructor. S-U grades optional. Cost of field trips, no more than $25. Offered alternate years.
T 1:25–4:25; several field trips usually taken weekdays, one overnight field trip to Albany. H. B. Brumsted.
A seminar devoted to analysis of selected current policy issues in wildlife management. Particular attention is given to citizen roles in policy development.

417 Wetland Resources Summer, 1 week at Shoals. 1 credit.
R. A. Malecki.
For description, see listing under "Courses in Marine Science" in the section on the Division of Biological Sciences.

[430 Dynamics of Animal Populations Spring. 2 credits. For seniors and graduate students in natural resources; others by permission of instructor. Offered alternate years. Not offered 1982–83.
T R 10:10. W. D. Youngs.
A quantitative examination of the dynamics of animal populations. Interactive computing is used to assist in analysis and understanding of mortality, growth, population estimation, and population interaction.]

438 Fishery Resource Management Spring. 3 credits. Prerequisite: Natural Resources 440 or permission of instructor.
Lecs, T R 8. Staff.
Principles and problems in the management of freshwater and marine fishery resources, considered in relation to problems of human population and management of other natural resources.

440 Fishery Science Fall. 3 credits. For seniors majoring in fishery science; others by permission of instructor. Prerequisites: a year of statistics and calculus. Offered alternate years.
M W F 12:20. W. D. Youngs.
Principles and theories involved in dynamics of fish populations. Methods of obtaining and evaluating statistics of growth, population size, mortality, yield, and production are considered.

442 Techniques in Fishery Science Fall. 3 credits. Limited to 15 upperclass and graduate fishery students. Cost of field trips, no more than $30.
T R 1:25–4:25; one or more weekend field trips. D. A. Webster.
Emphasis is on methods of collecting fish and related data when information on population dynamics is of paramount importance. Laboratories include field experience in use of gear and instruments. Opportunities for additional experience in ongoing college fishery-research program is provided.

443 Managing the Aquatic Environment Fall. 2 credits. Limited to 30 juniors and seniors not majoring in aquatic science.
Lecs, T R 10:10. R. T. Oglesby.
The nature of aquatic environments and effects of humans on them are initial foci. Wise use of aquatic resources is surveyed in terms of human impacts on them, including the introduction of toxicants and nutrients, removal or addition of particular biotic components, and modifications of the physical environment. Emphasis is on lakes, rivers, and estuaries. A case-history approach is used.

490 Practicum in Natural Resources Analysis and Management Fall. 5 credits. For seniors in natural resources; others by permission of instructors.
Hours to be arranged. Staff.
An in-depth exercise in planning the management of selected resources in a defined geographic area. Students work in groups under the supervision of a faculty committee with other faculty members acting as consulting experts. Student groups make oral and written reports on their management plans to a client panel of faculty members and outside evaluators.

493 (498) Research in Resource Analysis and Planning Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
R. A. Baer, H. B. Brumsted, E. E. Hardy, T. L. Hullar, J. W. Kelley, R. J. McNeil, B. T. Wilkins.

494 Research in Fishery Science Fall or spring. Credit to be arranged. S-U grades optional.
Hours to be arranged. J. L. Forney, S. P. Gloss, R. T. Oglesby, C. L. Schofield, D. A. Webster, W. D. Youngs.

495 Research in Wildlife Science Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
H. B. Brumsted, J. W. Caslick, T. A. Gavin, R. A. Howard, R. A. Malecki, A. N. Moen, M. E. Richmond.

496 Research in Forestry Fall or spring. Credit to be arranged. S-U grades; letter grade by permission of instructor.
Hours to be arranged. T. J. Fahey, J. P. Lassoie, R. R. Morrow, L. H. Weinstein.

500 Professional Projects—M.P.S. Fall and spring. Credit to be arranged. Limited to graduate students working on professional master's projects. S-U grades only.
Staff.

600 Waterfowl Biology Fall. 2 or 3 credits. Prerequisite: permission of instructor. Offered alternate years.
Lec-labs, T R 1:25–3; several extended field trips. R. A. Malecki.
An introduction to waterfowl and selected webless migrants. Emphasis is on the waterfowl resource in North America, identification of species, their ecological relationships, population dynamics, and management. Paper required for 3-credit option.

601 Seminar on Selected Topics in Fishery Biology Fall or spring. 1 credit.
Hours to be arranged. Staff.

602 Seminar in Natural Resources Analysis for Ecologically Based Planning Spring. 2 credits. S-U grades only.
M 2:30–4. T. J. Fahey.
Multidisciplinary graduate seminar. Theme changes each year but usually involves a case study of a specific area of land and water. Fieldwork usually required. Engineers, economists, sociologists, soil scientists, foresters, planners, and wildlife and fishery biologists are invited to bring expertise to the planning table.

603 Habitat Ecology Spring. 2 or 3 credits. Limited to 12 seniors and graduate students majoring in natural resources or biological sciences. Prerequisite: permission of instructor. Cost of field trips, no more than $20.
W 12:20–3. M. E. Richmond.
This course requires an understanding of broad ecological concepts relative to plant-wildlife interactions. The concepts of niche, habitat, and ecotope are addressed from the standpoint of island biogeographic principles, structural and spatial heterogeneity of the vegetation, community productivity, and temporal change. Major landforms and plant-animal communities of the northeastern United States will be visited during weekend field trips. Paper required for 3-credit option.

604 Seminar on Selected Topics in Resource Policy and Planning Fall. 1 credit. S-U grades only.
Hours to be arranged. Staff.
Primarily for graduate students majoring or minoring in natural resources conservation.

[605 Ecology and Management of Disturbed Aquatic Systems Spring. 3 credits. Limited to 20 seniors and graduate students. Recommended for

students specializing in the aquatic sciences. Prerequisite: limnology or oceanography. Offered alternate years. Not offered 1982–83.

Lecs, T R 10:10; disc, W or F 1:25–3:25; at least 1 S field exercise. R. T. Oglesby.

Lectures and readings focus on responses of aquatic ecosystems to stress and on significance of such reactions. Methods and strategies of management to minimize undesirable aspects of human activities are considered. Detailed case histories are studied and discussed.]

606 Marine Resources Policies Spring. 2 credits. Prerequisite: at least one related course such as Biological Sciences 364, 666, or 668, Natural Resources 438, or permission of instructor. S-U grades optional. Offered alternate years.

R 1:30–3:30. B. T. Wilkins.

A seminar discussing the law and issues concerning current marine policy questions such as coastal-zone management, marine fish regulations, marine mammal protection, and wetland preservation.

[607 Perspectives on Conservation Spring. 3 credits. For graduate students; others by written permission of instructor. S-U grades for graduate students. Offered alternate years. Not offered 1982–83.

R 1:25–3:30. B. T. Wilkins.

A seminar based on extensive readings of articles highlighting varying philosophical approaches to the conservation of natural resources. Views espoused by developmentalists, preservationists, naturalists, economists, and welfare economists are considered.]

608 Policies and Management of Natural and Wild Lands Fall. 2 or 3 credits (required field trip for 3-credit option). Prerequisite: permission of instructor. S-U grades optional.

Lec, T 9–11. T. L. Hullar.

Lectures, discussions, special seminars, readings, and case studies on natural and wild lands, particularly those in public ownership. Major topics include the values of these lands, social and scientific basis for their establishment, analysis of the policies for preservation and use, and methods and strategies for management. National and state wilderness systems, social and biological carrying capacity, effects of special interests, and current issues are covered. An independent study of a selected area is required.

609 Effects of Ecological Perturbations on Fishes Spring. 3 credits. Prerequisite: Biological Sciences 476 or permission of instructor. Cost of field trips, no more than $15.

Lecs, T R 9:05; lab, W 1:25–4:25; several field trips. S. P. Gloss.

Impacts of habitat alteration and physical-chemical pollutants, with emphasis on freshwater and diadromous fish species of North America. Direct and indirect effects of a variety of industrial and land-use practices on fish and other aquatic organisms with resultant changes in structure and function of fish communities due to lethal and sublethal responses are discussed. Laboratory includes several field trips.

610 Conservation Seminar Fall and spring. Noncredit. All graduate students in natural resources are expected to participate.

Hours to be arranged. Staff.

611 Seminar in Environmental Values Fall. 3 credits. For graduate students, juniors, and seniors. S-U grades optional. Cost of weekend trip, no more than $14.

W 1:25–3:50; two or three extra class sessions for presentations of papers and projects. Weekend trip in late September. R. A. Baer.

How the humanities, particularly religion, philosophy, and ethics, contribute to our understanding of the environment. In successive years, topics will include (1) the role of nonutilitarian values in our relationship to our natural environment, (2) land ethics, (3) new models for higher education in the age of ecology, and (4) concepts of growth and progress in Western culture and their impact on our treatment of the environment. Topic for fall 1982: The Ethics of Farmland Preservation.

612 Wildlife Science Seminar Fall and spring. 1 credit. Prerequisite: permission of instructor. S-U grades optional.

Hours to be arranged. Staff.

Discussion of individual research or current problems in wildlife science.

[614 Ecology and Management of Wetlands Fall. 3 credits. Limited to upper division and graduate students majoring in natural resources or biological sciences. Prerequisite: permission of instructor. Cost of field trips, no more than $25. Offered alternate years. Not offered 1982–83.

Lec-Labs T R 1:25–3:50. R. A. Malecki.

Lectures, readings, and field trips designed to develop an understanding and appreciation of freshwater and coastal wetlands, their function, classification, plant and animal associations, regulation, and management. Major wetland types in the northeastern United States are visited during one or two weekend field trips. Independent study of a selected area is required.]

800 Master's Thesis Research Fall and spring. Credit to be arranged. Limited to graduate students working on master's thesis research. S-U grades only.

Staff.

900 Ph.D. Thesis Research Fall and spring. Credit to be arranged. Limited to graduate students working on Ph.D. thesis research. S-U grades only.

Staff.

Related Courses in Other Departments

See department advisers and curriculum materials for information about other related courses.

Biology of Fishes (Biological Sciences 476)

Environmental Biology (Agriculture and Life Sciences 695)

Resource Economics (Agricultural Economics 250, 350, 450)

Image Analysis (Aerial Photo Interpretation) (Engineering CEE A687)

Insect Biology (Entomology 212)

Limnology (Biological Sciences 462)

Mammalogy (Biological Sciences 471)

Oceanography (Biological Sciences 461)

Ornithology (Biological Sciences 475)

Phycology (Biological Sciences 348)

The Vertebrates (Biological Sciences 274)

Plant Breeding and Biometry

W. D. Pardee, chairman; R. E. Anderson, W. R. Coffman, E. D. Earle, H. L. Everett, V. E. Gracen, Jr., P. Gregory, C. C. Lowe, H. M. Munger, R. P. Murphy, M. A. Mutschler, O. H. Pearson, R. L. Plaisted, R. R. Seaney, M. E. Sorrells, D. R. Viands, D. H. Wallace

Biometry courses are listed under "Statistics and Biometry."

225 Plant Genetics Spring. 4 credits. Prerequisite: one year introductory biology or permission of instructor.

Lecs, M W F 9:05; lab, W or R 1:25; lab section assignments at first lecture. Labs start first week. M. A. Mutschler.

An overview of genetic principles is related to plant sciences. Mendelian inheritance and cell mechanics, DNA as genetic material, genetic fine structure and gene regulation, gene recombination, linkage and mapping, gene interaction, extranuclear inheritance, environmental effect on phenotypic expression, gene mutation and chromosomal aberrations, variation in chromosome numbers, genes in populations, multiple gene inheritance, tissue culture, and genetic engineering. Students conduct an independent inheritance project with *Brassica campestris*.

401 Plant Cell and Tissue Culture Spring. 2 credits. Prerequisite: a course in plant physiology, cell biology, or genetics or permission of instructor.

Lecs, T R 10:10. E. D. Earle.

Lectures and demonstrations dealing with the techniques of plant tissue, cell, protoplast, embryo, and anther culture and the applications of these techniques to biological and agricultural studies. Current and proposed methods for plant improvement via manipulations of cultured cells will be discussed.

603 Methods of Plant Breeding Fall. 4 credits. Primarily for graduate students but open to qualified seniors who expect to engage in plant breeding. Prerequisites: Biological Sciences 101–102, Biological Sciences 281 or Plant Breeding 225, or equivalent; and field crops, vegetable crops, floriculture, or pomology. Students must enroll in this course by August 1.

Lecs, T R 8; labs, T R 1:25–4:15 (labs till 5 during first month). 2 S field trips. R. E. Anderson, H. L. Everett.

Breeding systems for producing commercial crop varieties are considered in detail. Laboratories include selection techniques, screening for heritable variation, and controlling pollination. Special emphasis is on selection for disease resistance and improved nutritional quality and on use of exotic germ plasm.

[605 Physiological Genetics of Crop Plants Spring. 3 credits. Prerequisites: either genetics, biochemistry, and plant physiology, or permission of instructor.

T R 8–10. D. H. Wallace. Not offered 1983.

Both genetic and environmental influences on biochemical and molecular control of plant variation in physiological phenomena like photosynthesis, respiration, translocation, self-incompatibility, male sterility, maturity, yield, and heterosis are discussed. Emphasis is on variation that can be exploited in plant breeding, particularly in breeding for higher yield and adaptability.]

608 Biochemical Analyses in Crop Science Fall. 3 credits. Limited enrollment. Prerequisite: Biochemistry 330 or permission of instructor. S-U grades optional. Students must enroll in this course by Aug. 27.

Lab, lecs, M W 1:25–5 (some lab sessions will run longer). P. Y. Bouthyette, P. Gregory.

Acquaints the student with specialized biochemical analyses commonly used in breeding programs and related aspects of crop science. Nutrients and toxicants of several crops are studied. Importance of developing an ability to critically assess the biochemical analysis is emphasized.

612 Experimental Methods Spring. 2 credits. Prerequisite: Plant Breeding 601 or permission of instructor. Offered alternate years.

M W F 12:20. C. C. Lowe.

The use of statistical methods and the application of experimental designs and plot techniques to problems in plant breeding and related agricultural research.

622 Seminar Fall or spring. 1 credit. S-U grades only.
T 12:20. Staff and graduate students.

[629 Special Topics in Plant Science Extension Spring. 2 credits. Not offered 1982–83.
F 1:25–4:25. W. D. Pardee.
Designed for graduate students and advanced undergraduates to provide a broader knowledge of cooperative extension philosophy and methods, and to prepare students for careers in extension and research or in related fields in public and commercial organizations. Topics relate to extension in other countries as well as in the United States.]

650 Special Problems in Research and Teaching Fall, spring, or summer. 1 or more credits by arrangement with instructor. Undergraduates must attach to their course enrollment material written permission of the staff member who will supervise the work and assign the grade.
Staff.

716 Perspectives in Plant Breeding Strategies Spring. 2 credits. S-U grades opional. Prerequisite: Plant Breeding 603.
R 12:20–2:15. M. E. Sorrells.
Selection techniques and breeding objectives, methods, and strategies for both self- and cross-pollinated crops are reviewed and discussed. Extensive outside reading is required. Emphasis is on discussion and evaluation of selected benchmark papers and current literature.

717 Quantitative Aspects and Related Issues of Plant Breeding Spring. 3 credits. Prerequisites: Plant Breeding 603 and Statistics 601. S-U grades only.
M W F 9:05. R. L. Plaisted, D. R. Viands.
Discussion of random-mating populations, inbreeding, components of variance, gene-pool development, and other issues pertaining to breeding of cross-pollinated crops.

718 Genetics and Breeding for Disease and Insect Resistance Fall, first 7 weeks of semester. 1 credit. Prerequisite: Plant Breeding 603. S-U grades only.
T R 10:10. V. E. Gracen.
Discussions of genetics and mechanisms of insect and disease resistance as they relate to the development and utilization of pest-resistant varieties.

Plant Pathology

W. E. Fry, chairman; J. R. Aist, P. A. Arneson, S. V. Beer, G. C. Bergstrom, B. B. Brodie, R. S. Dickey, M. B. Harrison, R. K. Horst, G. W. Hudler, H. W. Israel, E. D. Jones, R. P. Korf, J. W. Lorbeer, R. Loria, W. F. Mai, R. L. Millar, W. F. Rochow, W. A. Sinclair, R. W. Smiley, H. D. Thurston, H. D. VanEtten, R. E. Wilkinson, O. C. Yoder, M. Zaitlin, T. A. Zitter

301 Introductory Plant Pathology Fall. 4 credits. Prerequisites: Biological Sciences 101–102 and 103–104 or 105–106. Recommended: Biological Sciences 241 or equivalent.
Lecs, T R 11:15; lab, M T W R or F 2–4:25 plus one period weekly, scheduled at the convenience of the student. W. A. Sinclair.
An introduction to the theory and practice of plant pathology, with emphasis in lectures on principles that govern interactions of plants and pathogens, and in laboratories on diagnostic criteria, life cycles of pathogens, and epidemiological phenomena and control. Specific aspects considered in detail include fungi, bacteria, nematodes, viruses, and mycoplasmas as plant pathogens; attack and resistance mechanisms; environmental influences; disease forecasting and loss assessment; development of resistant plants; chemical and biological control.

309 Introductory Mycology Fall. 4 credits. Prerequisites: a year of botany or equivalent and permission of instructor.
Lecs, T R 1:25–2:15; labs, T R 2:30–4:25; and additional 2-hour period to be arranged. Required field trips. J. W. Lorbeer.
An introduction to fungi, emphasizing biology and comparative morphology rather than taxonomy.

402 Plant Disease Control Spring. 3 credits. Prerequisite: Plant Pathology 301 or equivalent.
Lecs, T R 11:15; lab and rec, T W or R 1:25–4:25. P. A. Arneson.
This course complements Plant Pathology 301 with an in-depth presentation of the principles and practices of plant disease control, building on the students' knowledge of diseases and their causal agents. General principles and concepts, illustrated by specific examples, are presented. Students write a term paper applying these principles to a specific disease-control problem. The laboratories provide practical experience in diagnosis and disease-control techniques.

443 Pathology and Entomology of Trees and Shrubs (also Entomology 443) Fall. 5 credits. Prerequisites: either Plant Pathology 301 and Entomology 292 or equivalent.
Lecs, M W F 10:10; labs, T R 1:25–4:25 or W F 1:25–4:25. W. T. Johnson, G. W. Hudler.
For students preparing for careers in horticulture, urban forestry, and pest management. Deals with the nature, diagnosis, assessment, and treatment of diseases and anthropod pests of trees and shrubs. Forest, shade, and ornamental plants are considered.

497 Special Topics Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for independent study of a special topic in mycology or plant pathology under the direction of a faculty member.

498 Teaching Experience Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
Undergraduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor.

499 Undergraduate Research Fall or spring. 3–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for research experience under the direction of a faculty member.

504 Pest Management for Plant Protection (also Entomology 504) Fall. 4 credits. Limited to seniors and graduate students. Prerequisites: Biological Sciences 360 or equivalent and two of the following: Agronomy 315, Entomology 440, or Plant Pathology 402.
Lecs, M W F 8; lab, M or W 1:25–4:25. P. A. Arneson.
Intended for practitioners in plant protection. Lectures integrate the principles of pest control, ecology, and economics in the management of pest-crop systems. A term project prepared by a team of four to five students is required and consists of a proposal for an extension pest-management program on a specific crop. Laboratories deal with pest-monitoring techniques and the application of computer simulation models to management problems.

641–655 Special Topics Series

Unless otherwise indicated, the following description applies to courses 641–655.

Fall or spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged.
Weekly discussions of current topics in special areas of plant pathology and mycology. Students are required to do extensive reading of current literature and to present oral and written reports.

641 Cytology of Plant Diseases
J. R. Aist, H. W. Israel.

642 Plant Disease Epidemiology
P. A. Arneson, W. E. Fry.

644 Soil-Borne Pathogens
R. W. Smiley, G. S. Abawi.

645 Plant Virology
M. Zaitlin, W. F. Rochow.

646 Plant Nematology
M. B. Harrison, W. F. Mai, B. B. Brodie.

647 Bacterial Plant Diseases
R. S. Dickey, S. V. Beer.

648 Pathogen and Disease Physiology
H. D. VanEtten.

649 Mycology Conferences
Fall: Agaricales, Gasteromycetes. Spring: Mycetozoa, Plasmodiophoromycetes. R. P. Korf.

650 Diseases of Vegetable Crops Fall only.
J. W. Lorbeer, R. E. Wilkinson.

651 Diseases of Fruit Crops
Autotutorial slide and tape sets. P. A. Arneson.
For graduate students and advanced undergraduates with a particular interest in fruit. Covers the economic importance, causal agents, symptoms, disease cycle, and control measures for the major diseases of fruit in the Northeast.

653 Dendropathology
G. W. Hudler, W. A. Sinclair.

654 Diseases of Florist Crops
R. K. Horst.

[655 Plant Diseases in Tropical Agricultural Development Spring. Not offered 1982–83.
H. D. Thurston.]

681 Plant Pathology Seminar Fall and spring. 1 credit. Required of all plant pathology majors. S-U grades only.
T 4:30–5:30. Staff.

701 Advanced Plant Pathology Spring. 4 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisites: Plant Pathology 301 and 309 or equivalent, *and* permission of instructor.
Lecs, T R 11:15; lab, T 2–4:25; disc, R 2–4:25. R. L. Millar.
Conceptual basis of plant pathology in terms of the nature of disease, etiology, stages in pathogenesis, epidemiology, and pest management. Laboratories involve exercises illustrating concepts; discussions integrate lectures and laboratory topics.

711 Biology of Plant Pathogens Fall. 4 credits. Limited to graduate students with a major or minor in plant pathology. Prerequisite: Plant Pathology 701 or equivalent with permission of instructor.
Lec, T R 11:15; lab, M W or T R 2–4:25. S. V. Beer and staff.
Provides instruction and practice in the diagnosis of plant disease and the biology of plant pathogens. All-important classes of plant pathogenic agents are considered. Classical and modern techniques are discussed.

[735 Plant Virology Spring. 4 credits. Prerequisite: permission of instructor. Not offered 1982–83; next offered 1983–84.
Lec (2); lab (2). M. Zaitlin.
Basic information on plant viruses and virus diseases. Laboratory experience in virus isolation, analysis, and diagnostic procedures.]

[736 Plant Nematology Spring. 3 credits. For graduate students with a major or minor in plant

pathology; others by permission. Prerequisite: permission of instructor. Not offered in 1982–83.
Lec, T R 9:05; lab, T 1:25–4:25. W. F. Mai, M. B. Harrison.
Anatomy, morphology, and taxonomy of plant parasitic forms and nonparasitic soil-inhibiting forms of nematodes are studied. Plant pathogenic forms are also considered from the standpoint of host-pathogen relationships, host ranges, life cycles, and the symptoms they cause. Principles and methods of control are discussed.]

737 Bacterial Plant Pathogens Spring. 3 credits. For graduate students with a major or minor in plant pathology. Prerequisite: Plant Pathology 701 and 711 or permission of instructor.
Lec, T R 9:05; lab, W or F 1:25–4:25. R. S. Dickey.
Basic information on bacterial plant diseases and phytopathogenic bacteria. The laboratory includes some of the more important techniques used in the study of bacterial plant pathogens.

[738 Molecular Mechanisms of Pathogenesis Fall. 2 credits. For graduate students with a major in plant pathology or special interest in molecular mechanisms of pathogenesis. Prerequisite: permission of instructor. Offered alternate years. Not offered 1982–83.
Hours to be arranged. H. D. VanEtten, O. C. Yoder, and staff.
This course deals with the molecular properties of both microorganisms and higher plants that control the development of host-parasite relationships. Contemporary molecular hypothesis are related to genetic mechanisms of pathogenesis. Emphasis is placed on a critical evaluation of the data that are used to support each specific hypothesis.]

739 Advanced Mycology Spring. 4 credits. Prerequisites: Plant Pathology 309 or equivalent, a course in genetics, and permission of instructor. Offered alternate years.
Lec, M 10:10; labs, M W 1:25–4:25 and an additional 3-hour period to be arranged. Optional field trips. R. P. Korf.
A detailed study of the biology and taxonomy of the major groups of plant pathogenic fungi (rusts, smuts, Fungi Imperfecti, Peronosporales), with emphasis on mechanisms of variation in fungi.

756 Advanced Plant Nematology Fall. 3 credits. For graduate students with a major in plant pathology and special interest in nematology. Prerequisite: permission of instructor. Offered alternate years.
Hours to be arranged. W. F. Mai, M. B. Harrison, B. B. Brodie.

759 Taxonomy of Fungi Fall. 4 credits. Prerequisites: Plant Pathology 309 or equivalent, genetics, plant or animal taxonomy, and permission of instructor. Offered alternate years.
Lec, M W 10:10; labs, M W 1:25–4:25; required field trips. R. P. Korf.
Emphasis is on the principles of taxonomy and nomenclature, critical evaluation of keys and monographs, and practice in identification. The Discomycetes are treated in detail.

797 Special Topics Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for independent study of a special topic.

799 Graduate Research Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.

Pomology

W. J. Kender, chairman; G. D. Blanpied, L. L. Creasy, J. N. Cummins, F. W. Liu, G. H. Oberly, R. M. Pool, L. E. Powell, W. C. Stiles, J. P. Tomkins, R. D. Way

100 Introductory Pomology Fall or spring 3 credits. S-U grades only for graduate students.
Fall: lecs, T R 8; lab, M or W 2–4:25. Spring: lecs, T R 8; lab, T or W 2–4:25. One half-day field trip required. G. H. Oberly, J. P. Tomkins.
A study of the general principles and practices of fruit culture and their relation to the underlying sciences. Included are tree fruits, grapes, small fruits, and nuts. Topics covered include propagation, varieties, crop management, and growth and fruiting habits. Practical work is presented in grafting, pruning, site and soil selection, and planting.

[208 Economic Fruits of the World Spring 3 credits. Prerequisite: introductory biology, or permission of instructor. Offered alternate years. Not offered 1982–83.
Lecs, M W 10:10; lab, F 2–4:25. F. W. Liu.
The more important subtropical and tropical fruits such as citrus, banana, pineapple, mango, coffee, and cacao are considered. Morphology, physiology, and adaptation to climate are stressed rather than details of culture. A broad view of world pomology is given.]

[302 Fruit-Tree Nursery Operation Spring, first 4½ weeks. 1 credit. Prerequisite: Pomology 100 or permission of instructor. S-U grades optional. Offered alternate years. Not offered 1982–83.
Lecs, M W 9:05; lab, M 2–4:25. J. N. Cummins.
This course is intended to familiarize the fruit producer with the operations and problems of the fruit-tree nursery operator. Topics include production objectives, management decisions, and cultural aspects of nursery operation. Techniques of grafting, budding, pest identification, inspection, and grading of fruit-tree planting stocks are included.]

304 Orchard Management I Spring. 3 credits. Prerequisite: Pomology 100.
Lecs, M W 8; lab, R 1:25–4:25. L. E. Powell, W. C. Stiles.
A treatment of problems of concern to fruit growers such as site selection, planting and pruning systems, water relations, cold hardiness, dormancy, flowering, and fruiting. Physiological and practical aspects are emphasized.

305 Orchard Management II Fall. 3 credits. Prerequisite: Pomology 100. Recommended: Pomology 304.
Lecs, M W 8; lab, R 1:25–4:25. G. H. Oberly, L. L. Creasy.
A continuation of the principles of pomology presented in Pomology 304. Subjects include the later stages of fruit maturation, quality, harvesting, aspects of tree nutrition, protection from pests, and regulatory policies affecting fruit production and sale.

[306 Small Fruits Spring, last 9 weeks. 2 credits. Prerequisite: Pomology 100 or permission of instructor. Offered alternate years. Not offered 1982–83
Lecs, M W 9:05; lab, M 2–4:25. J. P. Tomkins.
A study of the general principles and practices in the commercial culture of strawberries, brambles, blueberries, currants, gooseberries, elderberries, and cranberries.]

[307 Viticulture Fall. 3 credits. Prerequisite: Pomology 100 or permisssion of instructor. Offered alternate years. Not offered 1982–83.
Lecs, T R 9:05; lab, T 2–4:25. R. M. Pool.
Viticulture, with emphasis on the viticulture of the Great Lakes region, as a series of interrelated decisions on varieties, sites, vine management, and vine protection, is presented. Those decisions are based on ampelography, meteorology, soils, vine and grape anatomy and physiology, as well as protection of the vine and grapes from injuries, primarily diseases and insects.]

310 Postharvest Physiology and Storage of Fruits and Vegetables Fall. 3 credits. Prerequisite: a course in pomology or vegetable crops, or permission of instructor.
Lecs, M W 9:05; lab, F 2–4:25. One field trip is required. F. W. Liu.
The chemistry and physiology of fruits and vegetables as they affect quality and marketability are studied. Maturity indices, handling methods, and storage practices are considered. Practical work includes observations of the effect of handling and storage methods on quality and condition of fruits and vegetables.

311 Fruit Crop Systematics Fall, first 4½ weeks. 1 credit. Prerequisite: Pomology 100 or permission of instructor. S-U grades optional. Offered alternate years.
Lecs, T R 9:05; lab, T 2–4:25. G. H. Oberly.
The classification of fruit species is considered from a botanical and production viewpoint. The course deals with the identification and naming of fruit species and varieties and their botanical classification.

313 Utilization of Fruit Crops Fall, middle 4½ weeks. 1 credit. Prerequisite: Pomology 100 or permission of instructor. S-U grades optional. Offered alternate years.
Lecs, T R 9:05; lab, T 1:25–4:25. F. W. Liu.
A consideration of the fate after processing of fruits produced for consumption. The coverage of fruit products is generally limited to those commercially grown and processed in New York State. Although the discussion includes methods of canning, freezing, dehydration, and other types of processing, emphasis is on the quality requirement and proper handling of raw materials and how they affect the quality of end products.

315 Fruit Variety Improvement Fall, last 4½ weeks. 1 credit. Prerequisite: Pomology 100 or permission of instructor. S-U grades optional. Offered alternate years.
Lecs, T R 9:05; lab, T 2–4:25. R. D. Way.
The techniques and limitations of producing new varieties of perennial fruit crops are considered.

400 Undergraduate Seminar Spring. 1 credit (may be taken twice for credit). Prerequisite: a course in pomology. S-U grades only.
Hours to be arranged. Staff.
Seminar topics and speakers selected and arranged by the students on subject areas related to pomology.

402 Special Topics in Experimental Pomology Spring. 3 credits. Open to undergraduates by permission. Offered alternate years.
Hours to be arranged. Staff.
Selected topics are considered with respect to the current literature or experimental techniques. Topics reflect the research interests of the professors who participate.

[604 Growth and Development of Woody Plants Spring. 2 credits. Prerequisite: introductory plant physiology. Offered alternate years. Not offered 1982–83
T R 9:05. L. E. Powell.
An advanced course dealing with physiological, morphological, and biochemical changes during development, beginning with the seed and advancing through the mature reproductive plant. Hormonal control mechanisms emphasized.]

610 Research Fall or spring. 2 or more credits. Prerequisite: a course in advanced pomology. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Staff.

700 Graduate Seminar Fall. 1 credit. S-U grades only.
Hours to be arranged. Staff.
Reports by students on current research or literature in experimental pomology or related areas.

710 Teaching Experience Fall or spring. 1 credit. S-U grades only. Prerequisite: permission of instructor.
Hours to be arranged. Staff.
Designed to acquaint pomology graduate students with the methods and materials involved in teaching. The student participates in the design, delivery, and evaluation of segments of a departmental course.

Related Course in Another Department

General Horticulture (Vegetable Crops 103)

Rural Sociology

E. C. Erickson, chairman; M. L. Barnett, F. H. Buttel, H. R. Capener, E. W. Coward, Jr., G. J. Cummings, P. R. Eberts, E. C. Erickson, J. D. Francis, P. Garrett, C. C. Geisler, J. C. Preston, B. M. Scott, F. W. Young

100 Introduction to Sociology Fall. 3 credits.
Lecs, T R 10:10; disc, M or F 9:05, 10:10, 11:15, 12:20, 1:25, or 2:30. C. C. Geisler and staff.
An examination of the theories, concepts, and methods of sociology as they apply to sociology in general. Major topics include the origins of the discipline, its major theoretical and methodological currents, and its application to contemporary questions of power and bureaucracy, social and cultural change, materialism and sociobiology, social class, and community institutions. R Soc 100 is formally equivalent to 101 (offered in the spring), though less emphasis is placed on rural society and its problems.

101 Introduction to Rural Sociology Spring. 3 credits.
Lecs, T R 10:10; disc, M or F 9:05, 10:10, 11:15, 12:20, 1:25, or 2:30. Staff.
An examination of the theories, concepts, and methods of sociology as they apply to rural society, particularly in relation to major issues concerning the United States agricultural and food systems. Major topics include change in the structure of agriculture and in rural communities, inequality in rural America, the structure and functioning of agribusiness organizations, agricultural policy, energy and environmental problems, and alternative futures for rural development in the United States. R Soc 101, though placing greater emphasis on rural society, is equivalent to 100 (offered in the fall).

104 Proseminar: Issues and Problems in Rural Society Fall. 1 credit. S-U grades only.
R 12:20–1:25. Staff.
Introduces the student to subject matter of concern to both applied and academic rural sociologists. Focuses on such subjects as migrant workers, agribusiness, rural poverty, rural to urban migration, rural development, agricultural research and people, community development, small farmers in the less developed nations. These topics are explored through the use of films and group discussion.

105 Rural Sociology and World Development Problems Spring. 3 credits.
M W F 10:10. E. W. Coward, Jr.
An introduction to the analysis of some pressing social problems of contemporary Third World countries. Lectures and reading materials will present different approaches, analyses, and recommendations that follow from competing theories, in order that the student may determine which approach best explains the situation in Third World countries. Topics to be considered include visions of "development"; the social organization of peasant communities and large-scale agricultural enterprises; problems of land tenure and agrarian reform; the relationships among population growth, hunger, and employment; multinational corporations; social movements and social control.

175 Issues in Contemporary Native American Societies (also Anthropology 175) Spring; summer, 6-week session. 3 credits.
Spring: M W F 11:15. Summer: M T W R F 2–3:15. R. Fougnier.
Native American people are confronted with a myriad of special circumstances that impinge upon their everyday lives. The purpose of this course is to present background to these issues and give perspective from a Native American point of view. Early history and the postcontact period will be reviewed with an emphasis given to recent developments (1923–present). Topics such as land claims, treaties, education, mineral and water rights, social problems, militant organizations, and civil rights will be covered, with guest lecturers and media presentations giving added impact.

[213 Social Indicators and Data Management in Poor Countries Spring. 3 credits. Not offered 1982–83.
M W F 11:15. F. W. Young.
A survey of definitions and measures of welfare and social structure in poor countries. General principles of social-indicator research will be illustrated from data on Tunisia, Kenya, Mexico, etc., in the areas of poverty and level of living, inquality, agricultural productivity, environmental problems, and status restrictions on minorities and women. The course will cover measures based on census data, informant surveys, and household surveys, with an emphasis on simple and low-cost techniques. One-third of the course will be devoted to exercises in data management, using SPSS and microcomputers.]

240 Social History of American Agriculture Spring. 3 credits. No prerequisites.
T R 8:00–9:55. E. C. Erickson and staff.
A social and technical history of the changes in agriculture and the agricultural systems in the United States from about 1800 to the present day. Includes documentation of the technologies associated with agriculture as well as the rural social organization that supported the agricultural system (such as farm organizations, marketing systems, export patterns, transportation systems). Emphasizes the energy systems that included animal and human power in the eighteenth and nineteenth century, horsepower in the latter nineteenth century, steam and mechanical power from the early twentieth century onwards, and the managerial emphasis of the recent years.

324 Social Organization and the Environment Spring. 3 credits.
M W F 9:05. H. Capener.
A discussion of principles involved in our interaction with our physical environment, viewed from a human ecological and ecosystem perspective. Emphasis is given to the function of social organization in human-environment exchanges. Principles are illustrated by referring to both developing and developed societies. The course provides a conceptual framework for understanding and addressing recurring environmental issues.

350 Rural Poverty—Policies and Programs Fall. 3 credits.
M W F 11:15. M. M. Brown.
This course examines the persistence of poverty and underdevelopment in rural America. It focuses on the historical and contemporary perspectives of poverty among rural ethnic minorities. Past and present programs and policies aimed at eliminating rural poverty are assessed, and proposed new policies, nontraditional programs, and strategies are introduced.

355 Rural Development and Cultural Change Fall. 3 credits.
Lecs, T R 10:10; disc, T or R 11:15. M. L. Barnett.
An analysis of planned social-change programs in predominantly agricultural societies. Focusing on problems of administration, socioeconomic development, and the introduction of new practices.

356 Rural Society in America Fall. 3 credits. S-U grades optional.
M W F 9:05. H. Capener.
The focus is on gaining a greater understanding of and appreciation for the rural sector of American society. From sociological and historical perspectives, the nature of changes in rural society are examined, including the impact of technology on agriculture, other extractive industries, natural resources, the environment, regional variation, the rural-urban dominance theme, comparative life styles, cultural orientations, value patterns, and a look to the future.

357 Subsistence Agriculture in Transition Spring. 3 credits.
Lecs, T R 10:10; disc, T or R 11:15. M. L. Barnett.
An analysis of selected types of peasant communities, drawn from differing ecological conditions. Social structure, systems of farming and land-tenure arrangements, and motivational characteristics of subsistence farmers in the context of socioeconomic change. Theoretical and policy aspects of modernization and traditional agriculture, and programming for agricultural development.

360 The Old Order Amish: Folk Society or Model for the Future? Summer, 3-week session. 3 credits.
M T W R F 9–11:30. M. Olshan.
The relevance of Amish practices and attitudes to such issues as energy shortages, ecological deterioration, and the use of appropriate technology. Traditional or folk groups will be contrasted with Amish society, where innovations are selected on the basis of consistency with ultimate objectives. The extent to which the Amish may serve as a model for other societies. Comparison with such groups as the Hutterites and Utopian communes.

380 Independent Honors Research in Social Science Fall and spring. 1–6 credits. Limited to students who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program.
Staff.
Students must submit written proposals by the third week of the semester of their senior year to P. Garrett, departmental honors committee representative.

404 Intermediate Sociological Theory (also Sociology 404) Fall. 4 credits. S-U grades optional.
T 2:30–5. P. Eberts.
An advanced undergraduate seminar for senior majors in rural sociology and sociology. The course focuses on (1) the central concepts of the sociological tradition; (2) major classical theorists (Marx, Weber, Durkheim, Tocqueville) and contemporary counterparts; (3) application of the classical ideas in contemporary research.

410 Leadership and Authority in Group Relations: The Tavistock Approach Fall and spring. 2 credits. Limited to 18 (juniors, seniors, and graduate students). Prior experience with groups is preferred.
T R 2:30–4:25. H. Kramer.
Examination of group relations, leadership, and exercise of authority. Study of what happens in and among groups as it occurs. Special attention is paid to covert processes that influence groups. Students apply their learning to future professional interactions with client, community-development, task, or other work groups.

432 Community Development Fall. 3 credits.
T R 12:20–2:30. J. C. Preston.
Examines the major concepts, trends, and issues in community development from the perspective of the community-development change agent. Areas examined include community, community change, community action, community conflict, community leadership, citizen involvement, and strategies and tactics for planned community change.

436 Small Towns Seminar Spring. 2 or 3 credits. Prerequisite: Rural Sociology 100, 101, or 105.
W 2:30–4:25. G. J. Cummings.
The seminar reviews selected studies of small rural towns with a view to identifying theories and frameworks that examine planning and development strategies in a regional context. The objective is to identify the particular characteristics of centralized and decentralized approaches to small town development with a view to determining how each might be utilized for enhancing the quality of small town and rural life.

437 Aging: Issues and Strategies in the 1980s. Summer. 3 credits.
M T W R F 9:30–10:45. P. Taietz.
Interplay between basic and applied knowledge in social gerontology. Environment and aging. The role of the formal and informal networks of services in the maintenance of independent living arrangements by the elderly. Differences between rural and urban elderly in status, needs, services, and service costs. The impact of budget cuts on services for the elderly.

440 The Social Impact of Rapid Resource Development Fall. 3 credits.
T 7–10. C. Geisler.
The seminar defines social-impact assessment (SIA), and identifies alternative models of doing social-impact assessment and the experience various rural minorities have had with SIA, especially American Indians. Students will learn certain practical research skills needed in doing SIA and will participate in an SIA simulation in rural New York.

[443 Politics and Development Fall. 3 credits. Limited to upperclass and graduate students. Prerequisite: Rural Sociology 100 or equivalent. S-U grades optional. Not offered 1982–83.
M W F 1:25. P. R. Eberts.
Comparative analyses of politics as a significant process affecting development in both advanced and developing societies. Politics and policies are analyzed as results of pluralism and inequalities among various socioeconomic classes, different-sized firms and communities, and mutually interdependent institutions. They also are seen as major means of social control and resource redistribution in production, allocation, and service-staffing processes.]

445 Rural Social Stratification Fall. 3 credits. Letter grades only.
M W F 10:10. P. Garrett.
Principal issues to be considered in the course include theories of rural stratification in primarily agricultural and advanced industrial societies; social organization of agricultural enterprises; interrelationships among market and non-market, agricultural and nonagricultural activities; theories of change in stratification. Appropriate for majors in development sociology and international agriculture.

462 Health and Social-Economic Development Spring. 3 credits.
T R 2:30. G. J. Cummings.
An overview of health services is provided within the larger context of national social and economic development policies. Social-cultural, economic, and managerial factors are stressed as a basis for formulating realistic health planning and service implementation strategies. The allocation of resources to health and human service programs is examined against the backdrop of declining rates of economic growth. Conventional approaches to health services planning in industrial countries are evaluated in terms of their suitability for developing nations.

497 Informal Study Fall or spring. 1–3 credits (may be repeated for credit). S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
Informal study may include a reading course, research experience, or public service experience.

606 Contemporary Sociological Theories of Development Fall. 3 credits.
M W F 11:15. F. W. Young.
A review of theory, empirical studies, and policy prescriptions as applied to communities and regions, especialy those in less-developed countries. Human ecology, the Weberian tradition, central place, dependency, and symbolic structural theory are compared.

618 Research Design I Fall. 4 credits. Prerequisite: one course in statistics.
M W F 10:10; lab to be arranged. J. D. Francis.
First of a two-semester sequence (may be taken individually) in graduate methods. This course discusses problems of measurement, the design of measuring instruments, and problems of reliability and validity. Some common forms of measuring instruments are discussed, including multidimensional techniques. Students are expected to use actual data for labs.

619 Research Design II Spring. 4 credits. Prerequisite: an introductory methods course or a statistics course.
M W F 10:10; lab to be arranged. J. D. Francis.
The second part of the sequence in graduate methods deals with sampling frames, some pragmatic sampling techniques, and some discussion of statistical analysis procedures appropriate under each. An intermediate-level treatment of the following topics: nonexperimental designs, regression analysis, analysis of variance, analysis of covariance, and causal models. A classic piece of sociological research is one source of illustration and a component of the laboratory exercises. Students are expected to use actual data to familiarize themselves with data handling and processing.

[621 Environmental Sociology Spring. 3 credits. Not offered 1982–83.
W 1:25–4:25. F. H. Buttel.
An exploration of various sociological approaches to the study of society and its physical environment and an analysis of major issues relating to the survival base of human societies—particularly overpopulation, the energy and food crises, the limits-to-growth debate, and the conduct of political struggles over energy and environmental policy.]

641 Political Economy of Rural and Regional Development Spring. 3 credits. Limited to upperclass or graduate students. S-U grades optional.
T R 10:10–11:25. P. R. Eberts.
A survey of social, political, and economic factors in regional development. Theories and case studies from demography, human ecology, social organization, and planning are used to examine the emergence or retardation of regions and their implications for contemporary developing and developed societies.

[642 Regional Systems and Policy Analysis Spring. 3 credits. Prerequisites: a social or economic theory course and statistics, or permission of the instructor. S-U grades optional. Not offered 1982–83.
Lec, F 2:20–4:30; disc to be arranged. P. R. Eberts.
A systems analysis of theoretical and research problems arising from localities' changing social organization. Major theories are examined with attention to their compatibility with modern policy analytic techniques. Topics covered center on the interplay of economic, social class, and political activities in localities.]

[650 Social Organization of Agriculture Fall. 3 credits. Not offered 1982–83.
R 1:25–4:25. E. C. Erickson.
Concentrates on a small number of significant commercial crops, examining the institutions and relationships involved in the production process: research, credit, distribution of inputs, the farm operation, processing, transportation, and marketing. Patterns at the farm and community level, including topics such as settlement, land tenure, ethic groups, class structures, methods of cooperation, small farmers, labor problems, and information networks. Ecological and physical constraints on production. Emphasis on the influence of national and international structures—political, social, and economic—on the production process, including the role of government and quasi-government units. Examines the historical circumstances giving rise to the present crop systems. Consideration of what rearrangements of the political, social, and economic structures, both domestic and international, are required for change in crop systems, improvement in production, and increased social welfare.]

651 Structural Change in United States Agriculture Fall. 3 credits.
T 1:25–4:25. F. H. Buttel.
An analysis of the structural transformations of United States agriculture in the nineteenth and twentieth centuries, particularly in terms of the role of the state in agricultural development. This course emphasizes the historical roots of the socioeconomic problems of contemporary agriculture and examines the prospects for, and limitations of, various strategies for ameliorating these problems.

[706 State, Economy, and Society Spring. 3 credits. Recommended: one graduate-level course in classical sociological theory. Not offered 1982–83.
Hours to be arranged. F. H. Buttel, C. C. Geisler, P. Garrett.
Reviews major issues concerning the relations between political and economic institutions, including the political-economic methodologies of the classical sociological theorists, the instrumentalist-structuralist debate on the nature of the state, theories of crisis in advanced capitalism, and the controversies among theorists of unequal exchange, dependency, and imperialism in the world system.]

710 Theoretical Issues and Methodological Alternatives in Field Research Spring. 3 credits. Letter grade only.
R 1:25–4:25. P. Garrett.
A graduate seminar dealing with the design of field research, specifically the articulation of theory and methods. Readings illustrate different theoretical orientations and methodological techniques. Substantive problem areas considered include technological change, social stratification, dependency, and modes of production. Students explore theoretical issues and methodological alternatives applicable to their own research.

[712 Factor Analysis and Multidimensional Scaling Fall. 4 credits. Prerequisite: previous course work in scaling and statistics. Not offered 1982–83.
M W F 10:10; lab to be arranged. J. D. Francis.
An advanced course in measurement and scaling, building from work by Thurstone and Coombs to multidimensional measurements. Topics include philosophy of factor analysis, factor-analysis models, factoring design, factoring techniques, and comparison with factor-analysis models. Multidimensional scaling and discriminant analyses are also discussed. As matrix algebra is an integral part of these procedures, class time is devoted to this topic.]

[715 Macrosocial Accounting and Evaluation Spring. 3 credits. Not offered 1982–83.
R 1:25–4. F. W. Young.
A new methodology for monitoring and evaluating rural development projects based on data from informants, field analysis with a microcomputer system, and a generalized evaluation design. The

relationship of this method to conventional evaluation as well as to comparative subnational analysis of whole countries is reviewed.]

[717 Regression and Path Analysis Spring. 4 credits. Prerequisite: two courses in statistics and one in methods. Not offered 1982–83.
M W F 10:10; lab to be arranged. J. D. Francis.
The first part of the course reviews simple and multiple regression. Then extensions of these models are discussed. In the middle part of the course, consideration is given to violations of assumptions and their effects. Then more advanced regression concepts are discussed. The latter half of the course deals with recursive and nonrecursive path models.]

[723 Social Movements in Agrarian Society Spring. 3 credits. Not offered 1982–83.
T 1:25–4. F. W. Young.
The recent research explosion in this area is approached in terms of the several fundamental explanatory formats, a comparison of class-based and region-based movements, and research on the United States and the Third World.]

740 Community and Property Spring. 3 credits.
W 1:25–4:25. C. C. Geisler.
The seminar acquaints students with the evolution of property rights beginning in antiquity, and with the close association between changing property forms and community types as recognized by sociologists, both classical and contemporary. Readings will cover subjects such as land reform, the changing public interest in land-use regulation, and the "new feudalism" debate.

[741 Community Development and Local Control Spring. 3 credits. Not offered 1982–83.
Hours to be arranged. C. C. Geisler.
Theories of community growth and decline and the current debate over the place of local control in community development in general are considered. Salient themes include the role of neopopulism in community development, changing institutions of property as community development occurs, and changing definitions of "community."]

751 Applications of Sociology to Development Programs Fall. 3 credits.
R 1:25–4:25. E. C. Erickson.
A consideration of problems of implementing change strategies at national, regional, and institutional levels, especially as they relate to rural development. Focus is also on institutional constraints on the sociologist as a researcher, as a strategist, and as a participant, and on the different contexts within which developmental change occurs.

754 Sociotechnical Aspects of Irrigation (also Agricultural Economics 754) Spring. 3 credits.
Hours to be arranged. R. Barker, M. L. Barnett, E. W. Coward, Jr., G. Levine.
Examines irrigated agriculture and its relation to agricultural development. Emphasis on social processes within irrigation systems, and interactions with the social setting. The seminar provides an opportunity to examine systematically the institutional and organizational policy issues associated with the design and operation of systems of irrigated agriculture.

771 Special Seminar Fall or spring. Credit to be arranged. Limited to graduate students; others by permission of instructor.

791 Teaching Experience Fall or spring. 1–3 credits. Limited to graduate students. S-U grades only.
Staff.
Participation in the ongoing teaching program of the department.

792 Public Service Experience Fall or spring Credit to be arranged. Limited to graduate students. S-U grades optional.
Staff.
Participation in the ongoing public service activities of the department.

871–874 Informal Study Fall or spring. Credit to be arranged. Limited to master's and doctoral degree candidates with permission of the graduate field member concerned. S-U grades optional.

871 Rural Sociology

872 Development Sociology

873 Organization Behavior and Social Action

874 Methods of Sociological Research

881 Research Fall or spring. Credit to be arranged. Limited to master's and doctoral degree candidates with permission of the graduate field member concerned. S-U grades optional.

Statistics and Biometry

F. B. Cady, G. C. Casella, W. T. Federer, C. E. McCulloch, D. S. Robson, S. J. Schwager, S. R. Searle

Courses in statistics and biometry are offered by the Department of Plant Breeding and Biometry.

200 Statistics and the World We Live In Spring. 3 credits.
Lecs, T R 10:10–11:25; disc, M 10:10 or 1:25, or T 9:05, 1:25, or 2:30. Prelims: 6:30–8:30 p.m., R, weeks 4, 8, 13. G. C. Casellá.
Focus is on a better consumer understanding of statistical design, data collection, and information. Concepts of statistics, measurements and measuring instruments, data collection, principles of scientific investigation, survey design, questionnaire construction, experiment design, treatment design, graphs, tables, probability, averages, measures of variation, common distributions, confidence intervals, sample size, international and national statistics, and some simple statistical methodology are presented.

408 Theory of Probability Fall. 4 credits. Prerequisite: Mathematics 106, 108, or 112, or permission of instructor.
Lecs, M W F 10:10; disc, M 3:35. Prelims, 7:30 p.m. Oct. 12 and Nov. 16. S. J. Schwager.
An introduction to probability theory: combinatorics, random variables and their probability distributions, generating functions, and limit theory. Biological and statistical applications are the focus. Can serve as either a terminal course in probability or as a foundation for a course in the theory of statistics.

409 Theory of Statistics Spring. 4 credits. Prerequisite: Statistics 408 or equivalent.
Lecs, M W F 10:10; disc, M 3:35. Prelims, 7:30 p.m. Mar. 3 and Apr. 14. C. E. McCulloch.
The concepts developed in Statistics 408 are applied to provide an introduction to the classical theory of parametric statistical inference. Topics include sampling distributions, parameter estimation, hypothesis testing, and linear regression. Students seeking training in statistical methodology should consider Statistics 601–607.

416 Matrix Algebra I Fall. 2 credits. Prerequisite: precalculus mathematics. Dropping the course is not permitted after September 22.
Lecs, M W F 8; disc, M 1:25–2:15 (first 7 weeks). Prelim: 7–8:30 p.m. September 30. Final: 7–8:30 p.m. October 21. Warren 101 and 201. Staff.
Definitions, basic operations and arithmetic, determinants, and the inverse matrix. Emphasis is on understanding basic ideas.

417 Matrix Algebra II Fall. 2 credits. Prerequisite: Statistics 416 or permission of the instructor. No auditors. Dropping the course is not permitted after November 11.
Lecs, M W F 8; disc, M 1:25–2:15 (second 7 weeks). Prelim: 7–8:30 p.m. November 18, Warren 101. Final: during University exam week. Staff.
Rank, linear dependence, canonical forms, linear equations, generalized inverses, characteristic roots and vectors. Emphasis is on developing skills for applying matrix algebra.

498 Supervised Teaching Fall or spring. 2 credits. Limited to statistics and biometry undergraduates.
Staff.
The student assists in teaching a course appropriate to his or her previous training. The student will meet with a discussion or laboratory section and regularly discuss objectives with the professor in charge of the course.

499 Undergraduate Research Fall or spring. Credit to be arranged. Limited to statistics and biometry undergraduates. Prerequisite: permission of faculty member directing research.
Staff.

600 Statistics Seminar Fall or spring. 1 credit. S-U grades only.
W 3. Staff.

601 Statistical Methods I Fall. 4 credits. Limited to graduate students; others by permission of instructor.
Lecs, M W F 9:05 or 11:15; lab, M 12:20–1:50 (two sections), 2:30–4 (two sections), 7:30–9, or T 12:20–1:50 or 2:30–4 (two sections). When two sections meet simultaneously, one may be more mathematical than the other, depending on the availability and interest of students with a knowledge of calculus. Prelims: 7 p.m. Oct. 15 and Nov. 19. C. E. McCulloch.
Statistical methods, both parametric and nonparametric, are developed and used to analyze data arising from a wide variety of applications. Topics include point and interval estimation, hypothesis testing, inference for a single population, comparisons between two populations, one- and two-way analysis of variance, comparisons among population means, analysis of categorical data, and correlation and regression analysis. Interactive computing is introduced through the MINITAB statistical computing system. Emphasis is on basic principles and criteria for selection of statistical techniques.

602 Statistical Methods II Spring. 4 credits. Prerequisite: Statistics 601 or equivalent.
Lecs, M W F 9:05 or 11:15; lab, M 12:20–2:15 or 2:30–4:25, or T 10:10–12:05 or 12:20–2:15.
F. B. Cady.
A continuation of Statistics 601. Emphasis on (1) data analysis and inference for a wide variety of research situations using standard multiple regression programs, and (2) design of experiments. Topics include estimating and interpreting sequential and partial coefficients and sums of squares, prediction, residual plotting, model building, estimation of standard errors, principles and practice of randomization, replication and blocking, analysis of sample means from one-way and multiway classifications, factorial experiments, estimation of contrasts, covariance analysis, comparison of regression lines, model (variable) selection with many predictor variables. Selected topics from pairwise comparisons among means, transformations of data, response surface methodology, treatment design, weighted regression, split plot experiments, combining experiments, analysis of categorical data, and multivariate analysis. The SAS statistical computing package is used.

605 Applied Regression Analysis Fall. 1 credit. Prerequisite: Statistics 409 and 602.
Lecs, to be arranged (second 5 weeks of term).
G. C. Casella.
A continuation of Statistics 602, with emphasis on data analysis using a regression or linear model approach. Comparison of variable selection procedures. Biased estimation. Variable selection for

prediction. Regression approach to nonorthogonal analysis of variance situations. Case study for complex data set.

606 Sampling Biological Populations Fall. 1 credit. Prerequisite: Statistics 601 or equivalent. Offered alternate years.
Lecs, to be arranged (first 5 weeks of term).
D. S. Robson.
Standard methods of sample-survey design and estimation are presented, including stratified-random sampling, cluster sampling, double sampling, and variable probability sampling. Special emphasis given to methods of particular utility or specifically designed for biological sampling. Examples are taken from forestry, fisheries, and other biological areas.

[607 Nonparametric and Distribution-Free Statistical Methods Spring. 1 credit. Prerequisite: Statistics 601 or equivalent. Offered alternate years. Not offered 1982–83.
Nonparametric and distribution-free alternatives to normal-theory testing procedures are presented: randomization tests; location and scale tests for two populations; analyses for completely randomized, randomized blocks, and balanced incomplete blocks designs; comparisons among several means; correlation and regression; goodness-of-fit.]

662 Mathematical Ecology (also Biological Sciences 662) Spring. 3 credits. Prerequisites: a year of calculus, a course in statistics. Offered in alternate years.
Lecs, M W F 12:20. S. A. Levin, C. E. McCulloch.
Mathematical and statistical analysis of populations and communities: theory and methods. Spatial and temporal pattern analysis, deterministic and stochastic models of population dynamics. Model formulation, parameter estimation, simulation and analytical techniques.

699 Special Problems in Statistics and Biometry Fall, spring, or summer. 1 credit or more by arrangement with instructor.
Staff.

701 Advanced Biometry Spring. 3 credits. Prerequisites: Statistics 409 and 602.
T R 1:30–2:45. D. S. Robson.
Bioassay methods including parametric and nonparametric statistical analyses of quantal and graded response to controlled levels of single and multifactor stimuli; directional statistics as applied to animal orientation experiments; compartment models and analyses; enzyme kinetics and pharmacokinetic analysis; bioavailability.

[713 Experiment Design Fall. 4 credits. Prerequisites: Either Statistics 416 and 602 or equivalent. Offered alternate years. Not offered 1982–83.
Principles and techniques of experimentation, theoretical concepts, extensions and variations of the completely randomized, generalized blocked, and generalized row-by-column experiment designs, repeated measures designs, interval estimation for ranked means, transformations, unequal variances, additivity, residual analyses, sample size, variance component analyses, unequal number analyses, the place of orthogonality, balance and confounding in design, model selection, and advanced statistical methodology.]

714 Treatment Design and Related Experiment Designs. Fall. 4 credits. Prerequisites: Statistics 416–417 and 602. Offered alternate years.
Lecs, T R 8–9:50; disc to be arranged.
W. T. Federer.
Treatment design, the selection of treatments for an experiment, is divided into factorial, response surfaces, mixtures, and combinations of these. Single degree of freedom contrast matrices, factorial design theory for prime powers and nonprime powers, confounding, split plot, split block, complex confounded designs, lattice designs derivable from pseudofactorial theory, fractional replication, response surface designs, and designs and analyses for mixtures, including diallel crossing designs, are covered. Statistical analyses involving residual analyses and real data are included. Emphasis is on concepts and applications rather than mathematical manipulations.

[717 Linear Models Spring. 3 credits. Prerequisites: Statistics 409, 417, and 602 or Mathematics 472. S-U grades only. Offered alternate years. Not offered 1982–83.
Introduction to multinormal variables and distribution of quadratic forms; linear statistical models, estimable functions and testable hypotheses, regression models, experimental design models, and variance component models and combinations thereof.]

799 Statistical Consulting Fall and spring. 2 credits. Limited to graduate students.
Consulting, 1 hour a week; disc, 1 hour a week; hours to be arranged. Staff.
Participation in the Biometrics Unit consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions for joint consideration of selected consultations encountered by the service during previous weeks.

890–990 Research Fall or spring. Credit to be arranged. Limited to candidates for graduate degrees. Prerequisite: permission of the graduate field member concerned. S-U grades only.
Research at the M.S. (890) or Ph.D. (990) level.

Vegetable Crops

R. D. Sweet, chairman; L. Ellerbrock, E. E. Ewing, J. R. Hicks, W. C. Kelly, D. Lisk, P. M. Ludford, P. L. Minotti, H. M. Munger, M. A. Mutschler, R. F. Sandsted, L. D. Topoleski, D. H. Wallace, H. C. Wien

103 General Horticulture Spring. 4 credits. Each lab limited to 25 students.
Lecs, M W F 8; lab, M T W R 2–4:25.
L. D. Topoleski.
Acquaints the student with applied and basic horticulture. Primarily for students who want a general knowledge of the subject or who want to specialize in horticulture but have a limited background in practical experience or training in plant science. Includes flower, fruit, and vegetable growing and gardening techniques.

123 Organic Gardening Spring. 2 credits. Each section limited to 20 students. Primarily for students not enrolled in the College of Agriculture and Life Sciences. Prerequisite: permission of instructor.
M T W or R 1:25–4:25. W. C. Kelly.
Students must be prepared to lead a discussion and write a paper on some aspect of home gardening or amateur horticulture. Organic methods of gardening are discussed and demonstrated, but other methods are not excluded from the discussions.

210 Vegetable Types and Identification Fall. 2 credits.
T 10:10–12:05 or 2–4. L. D. Topoleski.
Acquaints the student with the vegetable species grown in the Northeast and the pests and disorders encountered in their production. Subjects covered include identification of economically destructive weeds, diseases and insects of vegetables, identification of vegetable and weed seeds, seedlings, nutrient deficiencies, vegetable judging, grading, and grade defects.

211 Commercial Vegetable Crops Fall. 4 credits. Each section limited to 25 students. Prerequisites: Vegetable Crops 103 and Agronomy 200.
Lecs, M W F 11:15; lab W or F 2–4:25; field trips (Sept.), W 11:15–6. E. E. Ewing.
Intended for those interested in the commercial vegetable industry from the viewpoint of production, processing, marketing, or the related service industries. Topics included are techniques, problems and trends in the culture, harvesting, and storage of the major vegetable crops, including potatoes.

312 Postharvest Handling and Marketing of Vegetables Fall. 3 credits.
Lecs, T R 9:05; lab, R 2–4:25; field trips in early fall.
J. R. Hicks.
Procedures used in marketing and shipping vegetables, including grade standards, methods of grading, packaging, harvesting methods, cooling principles, storage techniques, and market preparation.

401 Vegetable Crop Physiology Fall. 5 credits. Prerequisites: Vegetable Crops 211 and Biological Sciences 242 or equivalents.
Lecs, M W F 11:15; lab, M 2–4:25; disc, R or F 1, 2, or 3. W. C. Kelly.
Subjects include mineral nutrition as influenced by fertilization programs and crop sequence, nutrient interactions and induced deficiencies, growth and development, flowering, fruit setting, growth correlation, senescence, sex expression, photoperiodism, vernalization, and environmental factors affecting growth.

413 Kinds and Varieties of Vegetables Fall. 4 credits. Prerequisite: Vegetable Crops 211 or permission of instructor. Offered alternate years.
Lab, W F 2–4:25. H. C. Wien.
Designed to help students achieve proficiency in the evaluation of vegetable varieties through study of their origins, characteristics, adaptation, and usage. An important part of the course is the study of crops in the field. The vegetable seed industry is also discussed.

421 Plant-Plant Interactions Spring. 3 credits. Prerequisites: Any crop production course or permission of instructor.
Lecs, M W 8; disc, F 8. P. L. Minotti.
The manner in which plants affect the growth of other plants is examined with emphasis on crop situations rather than natural plant communities. Interactions in monoculture are considered as well as crop–associate crop interactions and weed-crop interactions. Fridays are devoted to a discussion of weed control methods widely used in the production of vegetable crops.

499 Undergraduate Research Fall or spring. 1 or more credits, by arrangement. Written permission from staff member directing the work must be obtained before course enrollment.
Hours to be arranged. Staff.
Special problems may be elected in any line of vegetable work.

601 Seminar Fall or spring. 1 credit. Required of graduate students majoring or minoring in vegetable crops. Limited to graduate students. S-U grades only.
R 4:30. Staff.

610 Special Topics in Vegetable Crops Fall or spring. 1 or more credits.
Hours to be arranged. Staff.

[612 Postharvest Physiology of Horticultural Crops Spring. 2 credits. Prerequisite: permission of instructor. Offered alternate years. Not offered 1982–83.
T R 8. P. M. Ludford.
Physiological and biochemical aspects of growth and maturation, ripening, and senescence of harvested horticultural plant parts. Topics include morphological and compositional changes in ripening and during storage life, some physiological disorders, aspects of hormone action and interaction, and a consideration of control.]

620 Teaching Experience Fall or spring.
1 or more credits by arrangement with instructor.
Hours to be arranged. Staff.
Participation in the teaching program of the department.

630 Research Methods in Applied Plant Science
Spring. 3 credits. Prerequisite: permission of instructor. Offered alternate years.
T R 9:05–11. W. C. Kelly.
The planning of applied research programs. The advantages and limitations of conventional experimental designs as they apply to specific research problems. Discussions include a critical interpretation of experimental results from the literature.

801 Master's Thesis Research Fall or spring.
Credit to be arranged. S-U grades only.
Hours to be arranged. Staff.

901 Doctoral Thesis Research Fall or spring.
Credit to be arranged. S-U grades only.
Hours to be arranged. Staff.

Related Course in Another Department

Special Topics in Plant Science Extension (Plant Breeding 629)

Faculty Roster

Abawi, George S., Ph.D., Cornell U. Assoc. Prof., Plant Pathology (Geneva)
Acree, Terry E., Ph.D., Cornell U. Prof., Food Science and Technology (Geneva)
Adleman, Marvin I., M.L.A., Harvard U. Prof., Floriculture and Ornamental Horticulture
Ainslie, Harry R., Ph.D., Kansas State U. Prof., Animal Science
Aist, James R., Ph.D., U. of Wisconsin. Assoc. Prof., Plant Pathology
Albright, Louis D., Ph.D., Cornell U. Assoc. Prof., Agricultural Engineering
Alconero, R., Ph.D., U. of Wisconsin. Assoc. Prof., Seed and Vegetable Sciences (Geneva)
Aldwinckle, Herbert S., Ph.D., U. of London (England). Assoc. Prof., Plant Pathology (Geneva)
Alexander, Martin, Ph.D., U. of Wisconsin. Liberty Hyde Bailey Professor of Soil Science, Agronomy
Allee, David J., Ph.D., Cornell U. Prof., Agricultural Economics
Anderson, Bruce L., Ph.D., U. of California at Berkeley. Asst. Prof., Agricultural Economics
Anderson, Ronald E., Ph.D., U. of Wisconsin. Assoc. Prof., Plant Breeding and Biometry
Apgar, Barbara J., Ph.D., Cornell U. Asst. Prof., Animal Science
Aplin, Richard D., Ph.D., Cornell U. Prof., Agricultural Economics
Arneson, Phil A., Ph.D., U. of Wisconsin. Assoc. Prof., Plant Pathology
Austic, Richard E., Ph.D., U. of California at Davis. Assoc. Prof., Poultry and Avian Sciences
Awa, Njoku E., Ph.D., Cornell U. Assoc. Prof., Communication Arts
Baer, Richard A., Ph.D., Harvard U. Assoc. Prof., Natural Resources
Bail, Joe P., Ph.D., Michigan State U. Prof., Education
Baker, Robert C., Ph.D., Purdue U. Prof., Poultry and Avian Sciences
Bandler, David K., M.P.S., Cornell U. Assoc. Prof., Food Science
Barbano, David M., Ph.D., Cornell U. Asst. Prof., Food Science
Barker, Randolph, Ph.D., Iowa State U. Prof., Agricultural Economics
Barnett, Milton L., Ph.D., Cornell U. Prof., Rural Sociology
Barton, Donald W., Ph.D., U. of California at Berkeley. Prof., Seed and Vegetable Sciences (Geneva)
Bartsch, James A., Ph.D., Purdue U. Asst. Prof., Agricultural Engineering
Bassuk, Nina L. Ph.D., U. of London (England). Asst. Prof., Floriculture and Ornamental Horticulture
Bauman, Dale E., Ph.D., U. of Illinois. Prof., Animal Science
Bayer, George H., Ph.D., Cornell U. Prof., Vegetable Crops
Beer, Steven V., Ph.D., U. of California at Davis. Assoc. Prof., Plant Pathology
Beermann, Donald H., Ph.D., U. of Wisconsin. Asst. Prof., Animal Science
Bergstrom, Gary C., Ph.D., U. of Kentucky. Asst. Prof., Plant Pathology
Berkey, Arthur L., Ph.D., Michigan State U. Prof., Education
Bills, Nelson L., Ph.D., Washington State U. Assoc. Prof., Agricultural Economics
Bing, Arthur, Ph.D., Cornell U. Prof., Floriculture and Ornamental Horticulture
Blandford, David, Ph.D., Manchester U. Assoc. Prof., Agricultural Economics
Blanpied, George D., Ph.D., Michigan State U. Prof., Pomology
Bloom, Stephen E., Ph.D., Penn State U. Prof., Poultry and Avian Sciences
Boisvert, Richard N., Ph.D., U. of Minnesota. Assoc. Prof., Agricultural Economics
Boodley, James W., Ph.D., Penn State U. Prof., Floriculture and Ornamental Horticulture
Bouldin, David R., Ph.D., Iowa State U. Prof., Agronomy
Bourke, John B., Ph.D., Oregon State U. Prof., Food Science and Technology (Geneva)
Bourne, Malcolm C., Ph.D., U. of California at Davis. Prof., Food Science and Technology (Geneva)
Bouthyette, Pierre-Yves, Ph.D., Cornell. Asst. Prof., Plant Breeding and Biometry
Bowers, William S., Ph.D., Purdue U. Prof., Entomology (Geneva)
Boyd, R. Dean, Ph.D., U. of Nebraska. Asst. Prof., Animal Science
Brake, John R., Ph.D., North Carolina State U. W. I. Myers Professor of Agricultural Finance, Agricultural Economics
Broadwell, George J., Ph.D., Cornell U. Assoc. Prof., Cooperative Extension
Brodie, Bill B., Ph.D., North Carolina State U. Prof., Plant Pathology
Brown, William L., Jr., Ph.D., Harvard U. Prof., Entomology
Bruce, Robert L., Ph.D., Cornell U. Prof., Education
Brumsted, Harlan B., Ph.D., Cornell U. Assoc. Prof., Natural Resources
Brunk, Max E., Ph.D., Cornell U. Prof., Agricultural Economics
Bryant, Ray B., Ph.D., Purdue U. Asst. Prof., Agronomy
Bugliari, Joseph B., L.L.B., Cornell U. Prof., Agricultural Economics
Burr, Thomas J., Ph.D., U. of California at Berkeley. Asst. Prof., Plant Pathology (Geneva)
Butler, Walter R., Ph.D., Purdue U. Assoc. Prof., Animal Science
Buttel, Frederick H., Ph.D., U. of Wisconsin. Assoc. Prof., Rural Sociology
Call, David L., Ph.D., Cornell U. Prof., Agricultural Economics
Campbell, Joseph K., M.S., Cornell U. Assoc. Prof., Agricultural Engineering
Capener, Harold R., Ph.D., Cornell U. Prof., Rural Sociology
Carruthers, Raymond I., Ph.D., Michigan State U. Asst. Prof., Entomology
Casella, George, Ph.D., Purdue U. Asst. Prof., Plant Breeding and Biometry
Casler, George L., Ph.D., Purdue U. Prof., Agricultural Economics
Chapman, Lewis D., Ph.D., U. of California at Berkeley. Prof., Agricultural Economics
Chase, Larry E., Ph.D., Penn State U. Assoc. Prof., Animal Science
Coffman, William R., Ph.D., Cornell U. Prof., Plant Breeding and Biometry
Colle, Royal D., Ph.D., Cornell U. Prof., Communication Arts
Combs, Gerald F., Jr., Ph.D., Cornell U. Assoc. Prof., Poultry and Avian Sciences
Compton, James L., Ph.D., U. of Michigan. Assoc. Prof., Education
Conneman, George J., Ph.D., Penn State U. Prof., Agricultural Economics
Conrad, Jon M., Ph.D., U. of Wisconsin. Asst. Prof., Agricultural Economics
Cooke, J. Robert, Ph.D., North Carolina State U. Prof., Agricultural Engineering
Coward, E. Walter, Ph.D., Iowa State U. Assoc. Prof., Rural Sociology
Creasy, Leroy L., Ph.D., U. of California at Davis. Prof., Pomology
Cummings, Gordon J., Ph.D., Cornell U. Prof., Rural Sociology
Cummins, James N., Ph.D., Southern Illinois U. Prof., Pomology and Viticulture (Geneva)
Cunningham, Danis L., Ph.D., Virginia Polytechnic Inst. Asst. Prof., Poultry and Avian Sciences
Cupp, Eddie W., Ph.D., U. of Illinois. Assoc. Prof., Entomology
Currie, W. Bruce, Ph.D., Macquarie U. Assoc. Prof., Animal Science
Cushman, Harold R., Ph.D., Cornell U. Prof., Education
Davis, Alexander C., Ph.D., Cornell U. Prof., Entomology (Geneva)
Day, Lee M., Ph.D., U. of Minnesota. Prof., Agricultural Economics
Delwiche, Eugene A., Ph.D., Cornell U. Prof., Microbiology
Dethier, Bernard E., Ph.D., Johns Hopkins U. Prof., Agronomy
Dewey, James E., Ph.D., Cornell U. Prof., Entomology
Dickey, Robert S., Ph.D., U. of California at Berkeley. Prof., Plant Pathology
Dickson, Michael H., Ph.D., Michigan State U. Prof., Seed and Vegetable Sciences (Geneva)
Dietert, Rodney R., Ph.D., U. of Texas at Austin. Asst. Prof., Poultry and Avian Sciences
Dockerty, Terence R., Ph.D., Ohio State U. Asst. Prof., Animal Science
Dolan, Desmond D., Ph.D., Cornell U. Assoc. Prof., Seed and Vegetable Sciences (Geneva)
Dondero, Norman C., Ph.D., Cornell U. Prof., Microbiology
Downing, Donald L., Ph.D., U. of Georgia. Prof., Food Science and Technology (Geneva)
Drake, William E., Ph.D., Michigan State U. Prof., Education
Duke, William B., Ph.D., U. of Illinois. Prof., Agronomy
Dunn, James A., Ph.D., U. of Michigan. Prof., Education
Duxbury, John M., Ph.D., U. of Birmingham. Assoc. Prof., Agronomy
Earle, Elizabeth D., Ph.D., Harvard U. Assoc. Prof., Plant Breeding and Biometry
Eberts, Paul R., Ph.D., U. of Michigan. Assoc. Prof., Rural Sociology
Eckenrode, Charles J., Jr., Ph.D., U. of Wisconsin, Prof., Entomology (Geneva)
Egner, Joan R., Ed.D., Cornell U. Prof., Education
Eickwort, George C., Ph.D., U. of Kansas. Prof., Entomology
Ellerbrock, LeRoy A., Ph.D., Cornell U. Asst. Prof., Vegetable Crops
Elliot, John M., Ph.D., Cornell U. Prof., Animal Science
Erickson, Eugene C., Ph.D., Michigan State U. Prof., Rural Sociology
Everett, Herbert L., Ph.D., Yale U. Prof., Plant Breeding and Biometry
Everett, Robert W., Ph.D., Michigan State U. Prof., Animal Science
Everhart, W. Harry, Ph.D., Cornell U. Prof., Natural Resources
Ewing, Elmer E., Ph.D., Cornell U. Prof., Vegetable Crops
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Fitzgerald, James A., Ph.D., Cornell U. Asst. Prof., Animal Science
Foote, Robert H., Ph.D., Cornell U. Jacob Gould Schurman Professor, Animal Science
Forker, Olan D., Ph.D., U. of California at Berkeley. Prof., Agricultural Economics
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Fox, Danny G., Ph.D., Ohio State U. Assoc. Prof., Animal Science
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Fry, William E., Ph.D., Cornell U. Assoc. Prof., Plant Pathology
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Hicks, James R., Ph.D., U. of Maryland. Assoc. Prof., Vegetable Crops
Hintz, Harold F., Ph.D., Cornell U. Prof., Animal Science
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Hood, Lamartine F., Ph.D., Penn State U. Prof., Food Science
Horst, R. Kenneth, Ph.D., Ohio U. Prof., Plant Pathology
Hotchkiss, Joseph H., Ph.D., Oregon State U. Asst. Prof., Food Science
How, Richard B., Ph.D., Cornell U. Prof., Agricultural Economics
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Jones, Edward D., Ph.D., U. of Wisconsin. Prof., Plant Pathology
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Keshavarz, Kavous, Ph.D., U. of Georgia. Asst. Prof., Poultry and Avian Sciences
Khan, Anwar A., Ph.D., U. of Chicago. Prof., Seed and Vegetable Sciences (Geneva)
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Knapp, Warren W., Ph.D., U. of Wisconsin. Assoc. Prof., Agronomy
Knapp, Wayne R., Ph.D., Purdue U. Assoc. Prof., Agronomy
Knoblauch, Wayne A., Ph.D., Michigan State U. Asst. Prof., Agricultural Economics
Korf, Richard P., Ph.D., Cornell U. Prof., Plant Pathology
Kosikowski, Frank V., Ph.D., Cornell U. Prof., Food Science
Kramer, John P., Ph.D., U. of Illinois. Prof., Entomology
Kubota, Joe, Ph.D., U. of Wisconsin. Prof., Agronomy
LaDue, Eddy L., Ph.D., Michigan State U. Assoc. Prof., Agricultural Economics
Lakso, Alan N., Ph.D., U. of California at Davis. Assoc. Prof., Pomology and Viticulture (Geneva)
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Lambert, Robert J., Jr., M.S., U. of Michigan. Prof., Floriculture and Ornamental Horticulture
Langhans, Robert W., Ph.D., Cornell U. Prof., Floriculture and Ornamental Horticulture
Lassoie, James P., Ph.D., U. of Washington. Asst Prof., Natural Resources
Lathwell, Douglas J., Ph.D., Ohio State U. Prof., Agronomy
Lawrence, James E., M.S., Syracuse U. Assoc. Prof., Communication Arts
Lazarus, William F., Ph.D., U. of Illinois. Asst. Prof., Agricultural Economics
Ledford, Richard A., Ph.D., Cornell U. Prof., Food Science
Lee, Chang Y., Ph.D., Utah State U. Prof., Food Science and Technology (Geneva)
Lee, David R., Ph.D., U. of Wisconsin. Asst. Prof., Agricultural Economics
Lesser, William H., Ph.D., U. of Wisconsin. Asst. Prof., Agricultural Economics
Levine, Gilbert, Ph.D., Cornell U. Prof., Agricultural Engineering
Lieberman, Arthur S., M.S., Cornell U. Prof., Floriculture and Ornamental Horticulture
Lienk, Siegfried E., Ph.D., U. of Illinois. Prof., Entomology (Geneva)
Linscott, Dean L., Ph.D., U. of Nebraska. Prof., Agronomy
Lisk, Donald J., Ph.D., Cornell U. Prof., Vegetable Crops
Liu, Frank W., Ph.D., Cornell U. Assoc. Prof., Pomology
Loehr, Raymond C., Ph.D., U. of Wisconsin. Liberty Hyde Bailey Professor of Agricultural Engineering
Lorbeer, James W., Ph.D., U. of California at Berkeley. Prof., Plant Pathology
Loria, Rosemary, M.S., Michigan State U., Asst. Prof., Plant Pathology
Lowe, Carl C., Ph.D., Cornell U. Prof., Plant Breeding and Biometry
Lucey, Robert F., Ph.D., Michigan State U. Prof., Agronomy
Ludford, Pamela M., Ph.D., Cornell U. Asst. Prof., Vegetable Crops
Ludington, David C., Ph.D., Purdue U. Prof., Agricultural Engineering
McBride, Murray B., Ph.D., Michigan State U. Assoc. Prof., Agronomy
McCormick, Charles C., Ph.D., North Carolina State U. Asst. Prof., Poultry and Avian Sciences
McCrimmon, Donald A., Ph.D., North Carolina State U. Asst. Prof., Natural Resources
McDowell, Robert E., Ph.D., U. of Maryland. Prof., Animal Science
McLellan, Mark R., Ph.D., Michigan State U. Asst. Prof., Food Science and Technology (Geneva)
McNeil, Richard J., Ph.D., U. of Michigan. Assoc. Prof., Natural Resources
Mai, William F., Ph.D., Cornell U. Liberty Hyde Bailey Professor of Plant Pathology
Malecki, Richard A., Ph.D., U. of Missouri. Asst. Prof., Natural Resources
Marsh, James A., Ph.D., Northwestern U. Asst. Prof., Poultry and Avian Sciences
Martin, Russell D., M.S., Cornell U. Prof., Communication Arts
Marx, Gerald A., Ph.D., U. of Wisconsin. Prof., Seed and Vegetable Sciences (Geneva)
Massey, Louis M., Jr., Ph.D., Cornell U. Prof., Food Science and Technology (Geneva)
Mattick, Leonard R., Ph.D., U. of Connecticut. Prof., Food Science and Technology (Geneva)
Merrill, William G., Ph.D., Cornell U. Prof., Animal Science
Metz, Joseph F., Jr., Ph.D., Cornell U. Prof., Agricultural Economics
Millar, Roy L., Ph.D., Cornell U./Prof., Plant Pathology
Miller, Dennis D., Ph.D., Cornell U. Asst. Prof., Food Science
Miller, Robert D., Ph.D., Cornell U. Prof., Agronomy
Millier, William F., Ph.D., Cornell U. Prof., Agricultural Engineering
Milligan, Robert A., Ph.D., U. of California at Davis. Assoc. Prof., Agricultural Economics
Millman, Jason, Ph.D., U. of Michigan. Prof., Education
Minotti, Peter L., Ph.D., North Carolina State U. Assoc. Prof., Vegetable Crops
Moen, Aaron N., Ph.D., U. of Minnesota. Prof., Natural Resources
Monk, David H., Ph.D., U. of Chicago. Asst. Prof., Education
Morrow, Robert R., Jr., Ph.D., Syracuse U. Prof., Natural Resources
Morse, Roger A., Ph.D., Cornell U. Prof., Entomology
Mortlock, Robert P., Ph.D., U. of Illinois. Prof., Microbiology

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